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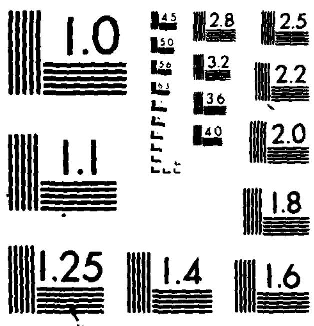

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963-A

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This bibliography provides a reference that will be of aid to those individuals and/or agencies planning or initiating limnological research on Lake Erie and/or its tributaries. The bibliography is divided into five sections: biological, chemical, engineering, physical, and socio-economic. Pertinent information from both United States and Canada are documented. The papers cited in the annotated bibliography are located at Great Lakes Laboratory of the State University College at Buffalo unless otherwise noted.

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Volume III. Engineering.

for

Buffalo District - Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

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by (11) Oct 74

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410736

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I. INTRODUCTION

The purpose of this study, which was sponsored under Contract DACW 49-74-C-0102 from the Buffalo District of the U. S. Army Corps of Engineers, was to provide a reference that would be of aid to those individuals and/or agencies, planning or initiating limnological research on Lake Erie and/or its tributaries. The task was divided on the basis of disciplines into five (5) sections - biological, chemical, engineering, physical and socio-economic.

The holdings of libraries in both the United States and Canada were surveyed. Each pertinent reference was abstracted and examined with respect to the location(s) in which the study was conducted, parameters measured and techniques employed. In addition, the last known address of the agency or senior author was included to assist in locating the author if further communication is desired.

Unless otherwise noted, the papers cited in the annotated bibliography are located at the Great Lakes Laboratory of the State University College at Buffalo.

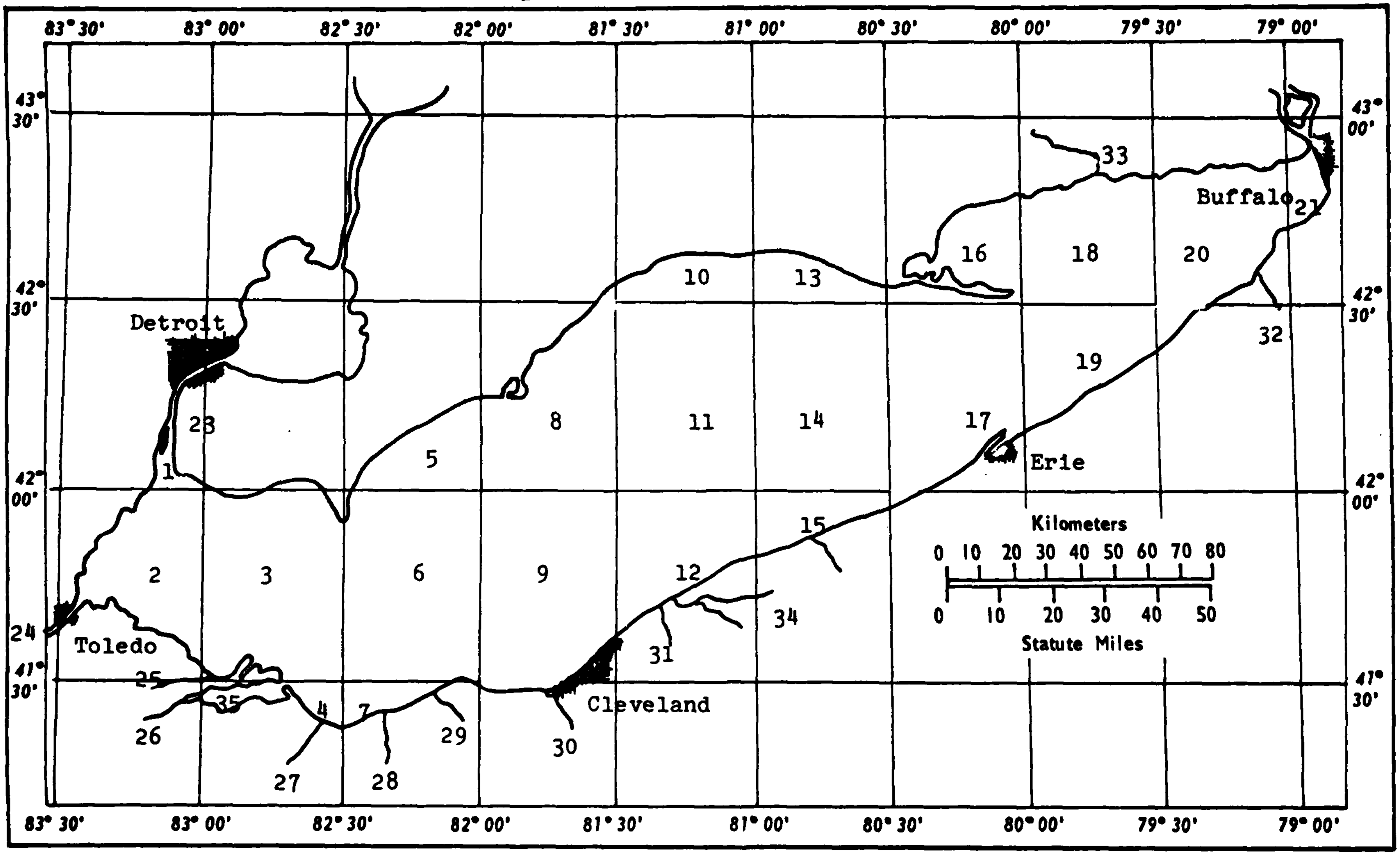
Due to limitations in time, we were unable to secure copies of all the references that may contain information relative to Lake Erie. These have been included in this paper.

II. SUBJECT INDEX

The number following each, refers to the number of the paper listed in Section III. Lake Erie was divided into twenty-one (21) regions, which are shown in Figure 1. The number twenty-two (22) refers to lake-wide studies; while numbers twenty-three (23) through thirty-four (34) concern specific tributaries to the lake. Thirty-five (35) concerns Sandusky Bay; while thirty-six (36) includes other tributaries.

A. STUDY REGIONS

Figure 1 - MAP OF LAKE ERIE



22 = Lakewide 36 = Other Tributaries

KEY TO FIGURE 1

#	Numerical	#	Alphabetical
1 - 21	Quadrants in Lake Erie	29	Black River
22	Lakewide	32	Cattaraugus River
23	Detroit River	31	Chagrin River
24	Maumee River	30	Cuyahoga River
25	Portage River	23	Detroit River
26	Sandusky River	34	Grand River (Ohio)
27	Huron River	33	Grand River (Ontario)
28	Vermilion River	27	Huron River
29	Black River	22	Lakewide
30	Cuyahoga River	24	Maumee River
31	Chagrin River	25	Portage River
32	Cattaraugus River	35	Sandusky Bay
33	Grand River (Ontario)	26	Sandusky River
34	Grand River (Ohio)	28	Vermilion River
35	Sandusky Bay		
36	Other Tributaries		

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29. Black River - 434, 436, 437, 443, 470, 553, 560, 561, 562, 566, 615, 635, 637, 655

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III. ABSTRACTS

Abbott, W. L. - See: Clifford Risley, Jr., No. 485.

1. Abu-Shumays, I. K., D. L. Phillips and S. M. Prastein. 1971. Thermal plume data acquistion, documentation and initial analysis. Internat. Assoc. Great Lakes Res. Proc. 14th Conf. Great Lakes Res. pp. 495-506.

This paper presents a brief description of the temperature, data acquisition and documentation procedure adopted by our interdisciplinary group at Argonne National Laboratory during the summer of 1970. As an illustration, we shall restrict ourselves to the 12 August 1970 thermal plume at the Commonwealth Edison Waukegan Station. Our aim has been to employ relatively simple and economic methods of acquiring and analyzing the data needed to explore thermal plume structure. The paper analyzes the accuracy of the procedure and furnishes a brief description of an initial computer program for documenting the data and displaying plume patterns.

We further stress the statistical nature of the thermal plume and describe what might be called a statistical plume and an average or representative plume.

Acres, H. G. - See: O. Holden, No. 308.

2. Adams, F. P. 1936. Grand River Water supply and flood prevention. J. Am. Water Works Assoc. 28(8):1117-1121.

Hydrology of Grand River in Ontario is reviewed with respect to flood control. Water quality of this river is also examined because it is used as a source of municipal water supply.

3. Adams, F. P. 1938. Flood control and water conservation in Southwestern Ontario. Eng. J. 21(5):71-77.

After sketching the geology and physiography of the Thames and Grand River watersheds, the paper outlines the history of flood control and construction works in the district and proposals for further construction. A brief general discussion of river control methods is also reported.
(UB)

Ahlert, R. C. - See: G. Biguria, No. 99.

4. Albright & Friel, Inc. 1957. Sewer and water plan, sanitary sewerage and storm drainage for Regional Planning Commission, Cleveland-Cuyahoga County. Ohio. 108 p. & 21 plates.

The purpose of this report is to coordinate the reports of the Four Area Engineers to insure the development of integrated systems for the collection and disposal of sewage and the handling of storm water within Cuyahoga County and beyond the limits of the County within the same drainage area (as is partly within the County). For this purpose, the report is based on the material presented in the separate reports of the Area Engineers. A second major purpose of our report is to study methods of financing the construction of the projects. (CE)

Alden, J. C. - See: D. G. Bardarik, No. 82.

5. Allen, R. H. and E. L. Spooner. 1968. Annotated bibliography of BEB and CERC publications. U.S. Army Corps of Engineers, Coastal Eng. Res. Center. Washington, D. C. Misc. paper no. 1-68. 141 p.

A bibliography of Beach Erosion Board publications from 1940 to 1963 and of Coastal Engineering Research Center publications from 1963 through 1967. A summary or abstract accompanies each title. Included is a list Beach Erosion Control Reports that have been published as House Documents. To aid the user there are indexes of authors, titles, and subjects.

Anderson, D. V. - See: J. P. Bruce, No. 121.

6. Anderson, D. V. 1966. Recirculation of water in the Great Lakes. Bull. of the I. A. S. H. 11(4):5-7.

It is remarked that water could be recirculated to Lakes Huron-Michigan from Lake Ontario since only 40 km separates their divides. Coupled with artificial regulation of the upper lakes and Lake Erie this scheme would appear to be more feasible than others that have been proposed to transport water from great distances to Central North America.

7. Anderson, D. V., D. H. Matheson and D. A. Whiteman. 1962. Tracking water movements with drogues positioned by radio direction finding. Univ. Mich. Great Lakes Res. Div. Great Lakes Res. Div. Pub. 9:77-85.

The trials of 1961 showed conclusively that the method will be a valuable addition in Great Lakes circulation studies. Continuity of observations is essential to understanding motion in terms of meteorological factors and other constraints on them. A proper observational program on any lake or part of a lake could not be mounted without substantial provision for round-the-clock observations, either by a corps of observers or with elaborate automatic equipment. Receiving sets could be mounted on trucks and moved along shore from time to time to follow lake-wide movements. For lake wide studies, a speedy boat would be useful to set out and retrieve the floats.

8. Anderson, D. V. and G. K. Rodgers. 1964. Lake Erie: Recent observations on some of its physical and chemical properties. Part I. Ontario Department of Lands and Forests. Ontario, Canada. Res. Rept. 54. 11 p. + 55 figures.

More study has been devoted to Lake Erie than the other Great Lakes and a sizeable body of descriptive information is available. It is the purpose of this report to add to that information data on the thermal and chemical regime of the Lake obtained in the course of development of the Great Lakes research programmes in Canada and in the United States. The principal sources of data were surveys conducted in 1955 and in 1960.

Anderson, T. W. - See: C. F. M. Lewis, No. 374.

9. Annett, C. S., M. P. Fadow, F. M. D'Itri and M. E. Stephenson. 1972. Mercury pollution and Lake Erie fishes. Mich. Academician 4(3):325-337.

Various sources of mercury contribute to the mercury contamination of Lake Erie in the vicinity of the Raisin River. To assess their extent, 79 fish and 37 sediment samples collected from this area of Lake Erie were analyzed by flameless atomic spectrophotometric techniques. The average concentration of total mercury in the muscle tissue of several species of fish ranged from 0.06 to 1.7 ppm on a wet weight basis and total mercury concentrations in the sediments ranged from 0.19 to 0.53 ppm on a dry weight basis.

10. Anonymous. 1896. A survey of a Great Lakes and Hudson River ship canal. Eng. News. 36(21):329-330.

A presentation of the principal facts and a discussion of the results, as based on data from a report by Albert J. Heines, are reported. No great accuracy is claimed for the estimates. The editor's views regarding the construction of a ship canal from the Great Lakes to the Atlantic Ocean are given briefly. (BL)

11. Anonymous. 1900. The Lake Erie regulating weir. Eng. Rec. 41(1):17.

This report gives a description of the barrage, which is proposed to be built across the foot of Lake Erie to maintain a fairly uniform depth of water in the Great Lakes. (BECPL)

12. Anonymous. 1900. Proposed plans for regulating works for controlling the level of Lake Erie. Eng. News. 43(12):198-200.

This report gives a brief illustration and description of the proposed design for the regulating works. An editorial discussion of the effect upon the levels of the St. Lawrence River is also provided. (BL)

13. Anonymous. 1900. Report of the Deep Waterways Board on the regulation of the Great Lakes. Eng. News. 43(1):11-13.

An abstract of the conclusions of the Board of Engineers appointed by Congress is given. The report also provides the editorial comment on this stupendous project for improving lake navigation. (BL)

14. Anonymous. 1900. A 6-cu. yd. Dipper Dredge for use on the Great Lakes. Eng. News. 43(9):138.

A 6 cubic yard Dipper dredge built for service on the Great Lakes is illustrated. Detail operation and engine itself are discussed. (BL)

15. Anonymous. 1902. Waterwaste in Cleveland. Eng. Rec. 45(8):173-174.

The study of water waste is receiving special attention in Cleveland. A preliminary and brief report is given on the sources and cost of treatment of these wastes. (BECPL)

16. Anonymous. 1903. A deep waterway from the Lakes to the Atlantic. Eng. News. 49(9):199-200.

Agitation for a ship canal or deep waterway from the Lakes to the ocean has been going on since the 70's; and, in the early 90's, the interest in it became such that conventions were held in the Lake cities to further the project. General descriptions are given for the route from Lake Erie to Lake Ontario by 9 locks. (BL)

17. Anonymous. 1908. The improvement of the Detroit River for navigation. Eng. News. 60(25):661-663.

The new Livingstone channel is demonstrated. A drill boat for rock excavation under water, in use on the Detroit River improvement, is illustrated. Plan of Cofferdam, etc. for excavating the Livingstone Channel in the dry Detroit River is outlined. (BL)

18. Anonymous. 1908. Operating results of the Buffalo refuse utilization plant. Eng. Rec. 58(19): 520-521.

A refuse utilization plant has been operated successfully in Buffalo since January 1905, in regard to both sanitary and financial results. Brief description on waste disposal and sewage pumping station are given. (BECPL)

19. Anonymous. 1909. Progress on the improvement of the Detroit River. Eng. Rec. 59(4):404-408.

The improvement of the Detroit River to provide a minimum depth of 22 ft. for down bound traffic and of 21 ft. for up bound traffic is being carried on according to a most comprehensive plan. Details of this plan is reported. (BECPL)

20. Anonymous. 1909. Recent improvements to the harbor at Cleveland Ohio. Eng. Rec. 59(3):66-67.

The provision of a harbor for the port of Cleveland has involved one of the largest projects of its kind that has been undertaken on the Great Lakes by the general government. Reconstruction of the breakwater and deepening of the harbor entrance are described. (BECPL)

21. Anonymous. 1910. Progress in the improvement of the Detroit River. Eng. Rec. 61(14):391-393.

The present work extends from the 22-ft. depth of water in Lake Erie to a point about five miles above the mouth of the river with a total length of close to 14 miles, in which two separate and distinct channels are being dug. One of these, the Livingston Channel will be for vessels passing down the river while the other, the Amhertsburg Channel, will be utilized exclusively by vessels bound up the river. The methods used for deeping the channel are also reported. (BECPL)

22. Anonymous. 1914. Pollution on tne Great Lakes. Eng. Rec. 69(5):123.

This report shows very painstaking and thorough examination of the extent of bacterial pollution. The International Joint Commission finds that the great bulk of water of the Great Lakes remains in its pristine purity, but that dangerous sewage pollution exists at certain points in the lakes and in the connecting waterways. (BECPL)

23. Anonymous. 1914. Sanitary survey of Boundary Waters between United States and Canada. Eng. Rec. 69(5):126-127.

Reports of extents of the International Joint Commission are given in brief. Discussion on extent and causes of pollution considered in waterways Treaty of Jan. 11, 1909 is mentioned. No data is provided. (BECPL)

24. Anonymous. 1915. Buffalo barge canal terminal. Eng. News. 7[illegible](24):1124-1125.

The New York Barge Canal will terminate at Buffalo, New York, in the Old Erie Basin, which is being deepened and improved for this purpose. The basin extends north along the shore line from the mouth of the Buffalo River to the new Black Rock Channel and is formed by the old New York State Breakwater of stone masonary. A brief report of this terminal is given. (BL)

25. Anonymous. 1915. Erie flood protection report. Eng. News. 74(20):937.

One of the highest flood figures on record is given for Mill Creek in a report on the Erie flood of Aug. 3, 1915, by Farley Gannett. The remedy measures and recommendations are suggested in this report. (BL)

26. Anonymous. 1915. Erie rainstorm and flood. Eng. News. 74(7):326-329.

Remarkable rainstorm with three heavy downpours, an hour apart, produced a sudden flood in a hillside stream flowing through Erie. The discharges from the three periods of greatest rain were synchronized. The creek channel constructed by some twenty culverts, are all overflowed. (BL)

27. Anonymous. 1916. Cleveland water supply to be purified and softened. Eng. News. 76(16):732-735.

Bacteria and turbidity will be removed and the hard water will be softened by lime treatment, coagulation with sulphate of iron and mechanical filtration. (BL)

28. Anonymous. 1922. Experience with breakwater design on the Great Lakes. Eng. News - Record. 89(17):684-688.

In breakwater construction on the Great Lakes both stone rubble and shaped concrete construction have been used extensively and successfully. But for both materials there are certain advantages and limitations. The selection in any one case is being based on the cost and suitability under the conditions of that particular case or structure. Case study in Ashtabula and Conneaut, Ohio, as well as some others, are illustrated. (BL)

29. Anonymous. 1931. Cleveland's projected new activated Sludge plant. Eng. News-Record. 107(27):1034-1036.

Sewage works for Easterly District will provide grease removal, presettling aeration and sedimentation with capacity of 123 million gal. per day. Sludge will be digested at Southerly Plant. Estimated cost: $12,000,000. (BL)

30. Anonymous. 1931. Cuyahoga River to be widened at bends. Eng. News-Record. 107(3):99.

Plans for straighting sharp bends of river through congested industrial valley region of Cleveland River is to be widened at bends and at narrow points to pass ore ships. (BL)

31. Anonymous. 1936. Buffalo solves its sewage problem. Eng. News-Record. 117(13):438-441.

Description of reconstructed sewage system is reported. It includes low level interceptors to divert dry weather flow to Bird Island, where sedimentation and chlorination will be provided. Tentative arrangement of sewage plant on Bird Island, plans for sewage treatment, main pumping station details, and sedimentation tanks are also discussed. (BL)

32. Anonymous. 1936. Cleveland adds new plant to its sewage disposal facilities. Eng. News-Record. 116(2):52-58.

This report gives description of 123 mgd. activated sludge plant now under construction in Easterly District of Cleveland, Ohio. It incorporates many original features, including grease separators and novel arrangement of sludge digestion units located 13 miles from plant site. (BL)

33. Anonymous. 1938. Special rigs speed concreting on Circular Sewage Tanks. Eng. News-Record. 120(9):338.

This report gives a brief description of mechanical aids for concrete placement in construction of two circular, sloping bottom sludge digestion tanks on the new Buffalo disposal plant. Tanks are 90 ft. in diameter, 20 ft. high with walls 12 inches thick. Details of rotating truss screed for sloping bottoms and whirligig chute for wall placement are mentioned. (BL)

34. Anonymous. 1940. Sludge filtration and incineration. Eng. News-Record. 124(11):75-78.

Operation of Sludge disposal equipment at Buffalo and at Minneapolis-St. Paul sewage treatment plants are illustrated. Equipment performance, incinerator abrasion troubles, and multiple hearth incineration are discussed. (BL)

35. Anonymous. 1941. Operating Cleveland's Sewage plants. Eng. News-Record. 127(13):75-77.

Analysis of first full year's operation data of Cleveland's 123 mgd Easterly activated sludge disposal plant, the remodeled 45 mgd Imhoff tank-trickling filter Southerly plant, the 36 mgd Westerly Imhoff plant (placed in operation in 1922) and effects of treatment processes at plants are reported. (BL)

36. Anonymous. 1943. Toledo water supply. Engr. J. 175(4544):136-138.; 175(4545): 146-149.; and 175(4546):164-165.

New system in Toledo is introduced. It is composed of nine features: intake crib in Lake Erie 2.5 miles off shore; large conduit that connects intake crib with low service pumping station; Lake Erie pipe line; filtration plant can furnish 80 mil. gal. per day; covered concrete reservoir; high service pumping station; elevated storage tank of 1 mil. gal. capacity; and 7 miles of high service trunk lines. (BECPL)

37. Anonymous. 1945. Permeable jetties built to protect Cleveland's shore. Eng. News and Record. 135(2):89.

The first of five projected permeable jetties has been completed at Cleveland as part of a program to halt erosion of the Lake Erie waterfront in Edgewater Park. The new groins are reported. (BL)

38. Anonymous. 1945. Sewage treatment at Detroit. Water and Sewage. 83(10):28-29, 54, 56-58, 60.

Description of sewage plant in Detroit includes, pumping station (holds 8 vertical centrifugal pumps of 2000 cfs total capacity), racks, grit chambers, sedimentation tanks and sludge collectors. Method of effluent discharge, sludge digestion tank and incineration equipment are briefly discussed. (BECPL)

39. Anonymous. 1946. Along waterfronts. Am. City. 61(8):92-94.

Report on beach shoreline and harbor improvements, planned by cities from coast to coast are outlined. Examples taken from San Francisco, Detroit, etc., are described. (LO)

40. Anonymous. 1946. Along Waterfronts--Part II--Resort and lakefront plans. Am. City. 61(9):125-127, and 161.

The plan for improving shoreline and harbor in Detroit, San Francisco, etc., are given. (LO)

41. Anonymous. 1951. Survey finds Lake Erie foul, Ohio Laboratory to help in clean up. Eng. News-Record. 147(2):39-40.

Data on coliform count from June to September, 1950, is reported on bacteria tests. Pilot plant will be built for sewage treatment research. (BL)

42. Anonymous. 1951. Two-in-one treatment plant means saving for industry. Eng. News-Record. 147(8):42.

Monroe, Mich. Ford Motor plant treats raw water before use, and waste water after use in combined treatment plant thus saving in initial costs, reducing operating personnel, chemical handling equipment and laboratory. (BL)

43. Anonymous. 1952. Effluent treatment plant for Tank Factory. Engineering 174(4531):681-684.

General Motors plant at Cleveland, Ohio manufactures 25 ton T41-El Walker Bulldog Tank. Rigid conditions imposed in connection with disposal of work's effluent results in design of treatment plant of unusual size and particular interest. Plant was required to deal with 550 U.S. gal. per min. of effluent on 24 hr. basis. Detailed description of the treatment plant is given. (BECPL)

44. Anonymous. 1955. Cleveland taps Lake Erie again. Eng. News-Record. 155(22):33-34.

Second stage of $33.5 million program to improve Cleveland, Ohio water supply is reported. Features of new 2 1/2-mi. intake line and Clague treatment plant located in Western part of city, which will furnish 50 mgd, are also reviewed. Crib is 60 ft. outside diameter and 10 ft. high, fabricated of 10Wf21 structural steel members with 3/4 and 1 in. plate welded to them. (LB)

45. Anonymous. 1956. For dredgers: 44,000,000 yards to go. Eng. News-Record. 157(4):26-28.

Overall project involves 44,000,000 cu. yd. of dredging at estimated cost of $150 million, in deepening Great Lake connecting channels from Lake Erie to upper lakes. The project includes channel deepening of St. Mary's River, Straits of Mackinac, St. Clair River, Lake St. Clair, Detroit River and removal of Pelee Island passage shoal. (BL)

46. Anonymous. 1965. Erie polluted: Ohio hollers uncle. Eng. News-Record. (April 8). p. 55.

"What we need is the same type of program as Appalachia, with the federal government and the states cooperating... The problem of pollution in the Great Lakes is too big a problem for one state." Governor of Ohio, James A. Rhodes.

47. Anonymous. 1965. HEW, State agree on Lake Erie cleanup. Eng. News-Record. (June 24). p. 20.

At the end of a five-day conference in Detroit called by the U.S. Department of Health, Education, and Welfare to discuss pollution in the Detroit River and the Michigan waters of Lake Erie, both state and federal authorities agreed that the waters should be under the jurisdiction of the Federal Water Pollution Control Act. Cities and industries must improve waste treatment.

48. Anonymous. 1966. New sewage treatment process uses coal. Am. City. 81(1):105, 148.

The future looks bright for a coal sewage treatment system that may represent the first new sewage treatment process in some 40 years. A test rig, treating mixed domestic and industrial wastes received at the Cleveland Ohio Easterly Sewage Plant, produced a clear effluent and obtained results equivalent to or better than that of a secondary sewage treatment plant. Comparison of results of coal system and conventional secondary treatment, based on Cleveland tests, is given in table form. (LO)

49. Anonymous. 1969. Ohio storms burst two reservoirs. Eng. News and Record. 183(3):13.

This report gives a brief description of the damage which resulted from the tornadoes and storms in Ohio. 23 counties were most severely affected. Damage reports of Bellevue and Cleveland are mentioned. (BECPL)

50. Anonymous. 1970. Applies existing technology for a clean Lake Erie. Am. City. 85(4):18.

Detroit intends to do its part to decelerate the aging of Lake Erie and is supporting this intention with a two year $159 million program. The program intends to reduce solids entering the receiving waters, to remove phosphates from the waste water, to use a new chlorine system, to remove oil and grease in the industrial waste, and to install a monitoring system to reduce stormwater overflows. (UB)

51. Anonymous. 1970. Regional sewer system is no dream in Detroit. Eng. News and Record. 185(24):24-25.

The regional program is designed to provide Wayne, Oakland, Macomb, Washtenaw, Monroe, and St. Clair counties with a system that will reduce water pollution in the Great Lakes and connecting waters and make seven rivers and many smaller streams available for recreational use. The program is briefly introduced. (BECPL)

52. Anonymous. 1971. U.S. and Canada agree on anti-pollution measures for the Great Lakes. EOS Am. Geophysical Union-Trans. 52(8):581-582.

The objectives of the International Joint Commission in their report on pollution of Lake Erie, Lake Ontario, and the St. Lawrence River, now adopted by the U.S. and Canadian foreign ministers in principle, would free all of the Great Lakes from effluents that would form sludges or putrescent deposits harmful to life, and from oil and flotsam from industrial or municipal discharges; nutrients would be controlled to acceptable levels that would not result in algal blooms. Although the commission recommended definite numerical limits on such things as pH, dissolved oxygen, iron, and phosphorus, the present agreement announces the intention of both countries to set 'compatible' standards. Canada has begun by setting national limits on phosphorus in detergents; the United States is relying on local and state regulation at the present time. (BECPL)

53. Ansbro, M. C. (Ed.). 1965. Billions slated for Lake Erie. Water in the News. Soap and Detergent Assoc. New York, N. Y. October. p. 3.

Program set up for new municipal sewage works, industrial waste treatment facilities, and related projects to remedy the gross pollution of Lake Erie.

54. Ansbro, M. C. (Ed.) 1966. Community action spurs clean-up of Cuyahoga River near Akron, Ohio. Water in the News. Soap and Detergent Assoc. New York, New York. May. p. 4.

Communities along the Cuyahoga River are taking corrective measures against polluting their water by building new sewage treatment plants.

55. Ansbro, M. C. (Ed.) 1966. Lake Erie, Lake Michigan, pollution discussed before Jones Subcommittee. Water in the News. Soap and Detergent Assoc. New York, New York. October. pp. 1, 3.

Hearing on water pollution in the Great Lakes and their drainage basins, held by the House Natural Resources and Power Subcommittee, focused on Lake Erie and its tributaries. Plans called for improved treatment and better stormwater control.

56. Ansbro, M. C. (Ed.) 1968. Progress, problems are reported at new session on Lake Erie. Water in the News. Soap and Detergent Assoc. New York, New York. July. pp. 1, 3.

Col. Amos L. Wright, District Engineer of the Corps of Engineers' Buffalo District, reported that a means of disposal and management of dredged materials should be determined so that they will not degrade the lakes' water quality. Offshore drilling in Pennsylvania was discussed.

57. Ansbro, M. C. (Ed.) 1968. FWPCA releases Lake Erie report. Water in the News. Soap and Detergent Assoc. New York, New York. November. p. 4.

The report, in a look at the estimated future population around Lake Erie, recommends immediate installation of advanced treatment facilities at municipal plants. Control of agricultural runoff is as necessary as any of the municipal and industrial treatment recommendations. Other recommendations were also discussed.

58. Ansbro, M. C. (Ed.) 1968. IJC issues two reports on pollution of Great Lakes and area waters. Water in the News. Soap and Detergent Assoc. New York, New York. December. p. 2.

The first report is a summary on pollution of the St. Mary's, St. Clair, and Detroit Rivers. The second interim report is on the pollution of Lakes Erie and Ontario and the international section of the St. Lawrence River.

59. Ansbro, M. C. (Ed.) 1969. Symposia on Cuyahoga, Lake Erie highlight AIChE National Meeting. Water in the News. Soap and Detergent Assoc. New York, New York. June. pp. 2, 4.

Symposia reviewed Cuyahoga River's problems, noting that many treatment plants have been built and are under construction to produce a pronounced effect on water quality in the river. Many of Lake Erie's problems were also discussed.

60. Ansbro, M. C. (Ed.) 1970. Working for clean water. Water in the News. Soap and Detergent Assoc. New York, New York. January. pp. 2-3.

Conclusion of report on investigation of potential oil pollution in Lake Erie from oil and gas drilling.

61. Ansbro, M. C. (Ed.) 1970. Abatement lagging, Erie Report notes. Water in the News. Soap and Detergent Assoc. New York, New York. July. p. 1.

Cities with pollution abatement schedules in the Lake Erie Basin have fallen behind schedule.

62. Ansbro, M. C. (Ed.) 1970. IJC issues interim report on Lakes. Water in the News. Soap and Detergent Assoc. New York, New York. July. p. 4.

International Joint Commission submitted its third interim report to the U.S. and Canadian governments concerning potential oil pollution, recommending what measures should be taken for abatement.

63. Ansbro, M. C. (Ed.) 1971. Pollution agreements reached with 3 cities. Water in the News. Soap and Detergent Assoc. New York, New York. August. p. 2.

The Environmental Protection Agency and the cities of Detroit, Cleveland, and Atlanta agreed on a program to curb the pollution of Lake Erie and Georgia's Chattahahoochee River.

64. Ansbro, M. C. (Ed.) 1971. Lake Erie rallying, so will Michigan, say experts regarding Great Lakes. Water in the News. Soap and Detergent Assoc. New York, New York. December. pp. 1,3.

Some reasons for Lake Erie's rallying from a predicted premature death.

65. Ansbro, M. C. (Ed.) 1972. U.S.-Canada Lake Pack asks control of phosphorus by waste treatment. Water in the News. Soap and Detergent Assoc. New York, New York. May. pp. 1,3.

The U.S. and Canadian governments agreed on both general and specific objectives to enhance the Great Lakes water quality.

Applegate, V. C. - See: J. F. Carr, No. 141.

Archiball, S. W. - See: O. Holden, No. 308.

66. Armstrong, J. M. and J. T. McFadden. 1971. Ecological and systems planning for the Great Lakes. J. Water Pollution Control Federation. Paper no. 32412. 43(12):2420-2413.

A large-scale systems analysis project at the University of Michigan is carried out to develop protective ecological models of the Great Lakes. Exploration of resource development alternatives will be carried out by manipulation of predictive models of the marine resources system and the directly interlocking parts of the socio-economic system.

67. Arnold, D. E. 1970. Thermal pollution, nuclear power and the Great Lakes. Limnos. 3(1):3-12.

This report discussed the increase of nuclear power plants in relation to their thermal waste and radiological waste into the Great Lakes region. The regulation of thermal pollution, heated effluents by law, is reviewed.

68. Arnold, D. E. 1971. Lake Erie alive but changing. The Conservationist. December-January 1970-1971. 36:23-30.

The idea has become popular that Lake Erie is dead. In a real sense this is far from the truth. By any common measurement there is more life going on in Lake Erie now than there has ever been in the past. What has died is the community structure that existed in the good old days. It consisted largely of organisms which we have been conditioned to consider desirable, but which have been replaced by others more adapted to the present conditions. Various components of the Lake Erie system are examined to see how and why they are changing.

69. Arnold, G. E., W. W. Aultman, R. M. Boardman, H. C. Carbaugh, M. A. Churchill, J. V. Cleary, R. W. Dennis, J. E. Edinger and H. B. Gerber. 1967. Bibliography on thermal pollution. Proc. Am. Soc. Civil Engr. J. Sanitary Eng. Div. #5303, SA 3:85-113.

The initial charge of the ASCE Committee on Thermal Pollution of the Sanitary Engineering Division was to investigate and correlate available information regarding the effect, from a sanitary engineering standpoint, of the unnatural increase or decrease of water temperature caused by the industrial use of water. The general categories of the resulting bibliography include (1) general properties of heat and heat exchange between water and atmosphere, (2) effects of heated discharges on the receiving body of water, and (3) effects of heated discharges on uses made of the receiving body of water. Categories (2) and (3) contain the greater number of articles; specifically studies on cooling ponds, water supplies, lakes and reservoirs, rivers and streams, and effects on aquatic life. The bibliography is in alphabetic order according to the author. It is not in any order based on the classifications given above. 881 papers have been listed.

70. Asbury, J. G. and A. A. Frigo. 1971. A phenomenological relationship for predicting the surface areas of thermal plumes in lakes. Argonne National Lab. ANL/ES-5. Argonne, Ill. 19 p.

A phenomenological relationship for surface areas within isotherms has been developed for thermal plumes in large lakes. The relationship, based upon the field data of other investigators, represents a useful rule of thumb for predicting surface areas of buoyant thermal plumes.

71. Asbury, J. G. R. E. Grench, D. M. Nelson, W. Prepejchal, G. P. Romberg and P. Siebold. 1971. A photographic method for determining velocity distributions within thermal plumes. Argonne National Lab. ANL/ES4. Argonne, Ill.

The direct field measurement of velocity distributions appears to be a feasible, complementary method for examining the structure of thermal plumes. The photographic technique described can provide accurate, nearly synoptic plume-velocity data. The data reduction technique used in the present study was primitive; however, the semi-automatic digitizing of drift-bottle coordinates using machines of the SCAMP or HERMES type appears feasible and offers the possibility for fast, accurate data processing. The measurements reported here pertain only to surface water velocity distributions. A more complete plume description will require the measurement of velocity distributions function of depth.

Assur, A. - See: S. L. Dingman, No. 200.

Aultman, W. W. - See: G. E. Arnold, No. 69.

72. Aultman, W. W., L. R. Howson, W. A. Lyon, D. A. Lazarchik, H. W. Poston and G. J. Remus. 1966. Waste disposal waste treatment plants - Joint discussion. J. Water Works Assoc. 59(9):1102-1116.

The discussion consists of five parts. The first part is given by Aultman, reporting general waste disposal study. The second part discusses pollution problem due to waste which is given by Howson. Lyon and Lazarchik give a brief discussion on the influence of State Quality Standards on the Sanitary Wastes from filtration plants, while Poston talks about Federal Pollution Control. Details of Detroit's waste water problem is presented by Remus. (UB)

Ayers, J. C. - See: C. F. Powers, et al, No. 465.

Ayers, J. C. - See: J. T. Wilson, No. 682.

73. Ayers, J. C. 1960. Status and programs. Univ. Mich. Great Lakes Res. Div. Pub. 4:61-74.

The Great Lakes Research Institute began its active research program in 1954. Since then it has carried on a continuing and rather large group of Great Lakes studies. This paper reports the present status of the Institute. Pilot study of Lake Erie is briefly reviewed. (RL)

74. Ayres, L. E. 1929. Detroit flood hazards from periodic lake rises. Eng. News-Record. 103(12):458-461.

The water level of the Great Lakes rise and fall with approximate periodicity. From peak to peak of high water the time is about ten years. There was high water in 1919 and again in 1929 with an exceptionally low water period between. In this period, Detroit in its rapid growth spread out over low lying areas, bordering the Detroit River, provides no defense against the high water to come. Thus the high water of 1929 flooded homes and business places and damage was done. This review of lake levels and flood hazards at Detroit is, therefore, of outstanding importance. Their excellent presentation by Mr. Ayres also gives interest to the facts and discussion. (BL)

Bajorunas, L. - See: I. A. Hunt, No. 317.

75. Bajorunas, L. 1960. Littoral transport in the Great Lakes. In: Proc. 7th Conf. Coastal Eng. The Hagne, Netherlands. 1:326-341.

Littoral transport has been defined as the movement of material along the shore in the littoral zone by waves and currents. Shore erosion, littoral transport and deposition of drift are all factors in the littoral process. This paper analyzes this littoral transport problem by using transport equation and the observations are used on rate of littoral transport, deepwater wave energy, length and alignment of shore, available shores, material and the material transport. (UB)

76. Bajorunas, L. 1963. Natural regulation of the Great Lakes. Univ. Mich. Great Lakes Res. Div. Proc. 6th Conf. on Great Lakes Res. Pub. 10:183-190.

The water level in the Great Lakes changes very gradually and the outflow is extremely uniform despite the large variation in water supply and the inflow or outflow corrections by man. Methods and equations are presented to evaluate the natural adjustment of lake levels and outflows. Two examples are shown. In the first example, the effects are computed from an imaginary man-made change in inflow, and the second example evaluated the effects of ice-jamming in one of the rivers.

77. Bajorunas, L. 1964. Coastal engineering research on the Great Lakes. In: Proc. 9th Conf. Coastal Eng. Lisbon, Portugal. 726-732.

Collection and study of field data related to coastal engineering is underway for the following problems: wind over the lakes and its relationship with wind record on land; wave characteristics and effect of wind and environment; water level disturbances and mathematical relationship with acting forces; currents in harbors and factors affecting them; and littoral transport. (UB)

Baker, J. L. - See: P. E. Chase, No. 143.

Baker, R. F. - See: R. Chieruzzi, No. 145. (CE)

Ball, R. C. - See: J. J. Roosen, No. 493.

78. Ballert, Albert G. and Goodsell, Leonard J. 1969. The Saint Lawrence Seaway 1859-1969. Limnos. 2(2):3-11.

Use of the St. Lawrence waterway as a trade route to link the highly important and expanding mid-continent area with other sections of the formidable rapids along the upper St. Lawrence and the famous falls on the Niagara. Projects have been carried out over the last century and a quarter to overcome these obstacles and provide a through waterway between the Atlantic and the Lakes. In 1932, the Welland Canal was improved from 26 locks used earlier to 8 locks, to overcome the 326-foot difference between levels of Lakes Erie and Ontario.

79. Balsillie, J. H. and D. W. Berg. 1972. State of groin design and effectiveness. Proc. 13th Coastal Eng. Conf. Vancouver, B. C., Canada. pp. 1367-1383.

An annotated bibliography on groins, compiled by Ralsillie and Bruno (1972), has provided the background for this paper. A review of functional design criteria is presented including groin length, height, spacing, permeability-adjustability, and orientation. A discussion of coastal processes and their relationship to groin design and effectiveness is also given.

80. Balsillie, J. H. and R. O. Bruno. 1972. Groins: an annotated bibliography. Corps of Engineers. Coastal Eng. Res. Center. Washington, D. C. Misc. paper # 1-72. 249 p.

A groin is a shore protective structure built (usually perpendicular to the shore) to trap littoral drift or to retard erosion of the shore. Considering all types of shore protective structures used by coastal engineers, the groin is on of the most controversial and most difficult to design. Because the functional and structural guidelines for design are incomplete, many groin installations fail to fulfill their intended purpose. CERC supports a continuing research program devoted to gaining a better understanding of groins. This bibliography evolved from the groin research program.

About 460 articles published since 1900 on groins and groin-type structures are presented in this bibliography. Annotations accompany each bibliographic entry where possible Indexes of authors, titles, and subjects are included to aid the researcher. Unavailable literature such as foreign articles, although not annotated, are included as entries in both the annotated section and the indexes.

81. Barbalas, L. X. (Ed). 1973. Great Lakes Research Project forecasts directory. NOAA Tech. NOS LSC D 5. Lake Survey Center. Detroit, Mich.

The directory describes over 270 proposed, continuing, and completed Great Lakes water-related research and development projects, technical reports, theses, and data surveys during 1973. It was compiled from volunteered information. Seven indexes are provided, as follows: (1) Organizational; (2) Geographical ; (3) Subject field; (4) Procedures and services; (5) Mode of investigation; (6) Platforms and equipment; and (7) Principal investigators.

82. Bardarik, D. G., J. C. Alden, R. L. Shema and A. R. Kupiec. 1971. Interim report: A study of the effects of heated discharges on the ecology of Presque Isle Bay, Erie, Pennsylvania. Env. Sci. Inc. Pittsburgh, Pa. 232 p.

Temperature and dissolved oxygen readings were taken at weekly intervals. Isotherm maps and verticle temperature profiles were constructed from the data thus gathered. A general pattern of heat distribution from the discharge into the bay showed that most of the heat had dissipated within a short distance past the harbor line. There was definite thermal stratification and the presence of an induced thermocline in the west boat basin. Other areas within the bay were at all times homothermous. Dissolved oxygen values were for the most part sufficient to support aquatic organisms. The effect of the heated discharges on the ecology is examined.

83. Bar-Kochba, Y. and A. J. Simon. 1971. Rainfall and floods in Northeastern Ohio. Dept. of Eng. Univ. Akron. 87 p.

This paper attempts to fill an apparent need in the Northeastern Ohio region for reliable statistical information on rainfall and floods. Practically all available records were incorporated, in some cases up to forty years of data, and a number of hydrologic variables were considered in the analysis. The data was processed with the IBM 360 Model 50 computer of the University of Akron. (CE)

84. Barnhouse Associates, Inc. 1971. Existing sewer & water facilities, water & sewer plans. Planning Div. Ohio Dept. of Development. Vol. III, comprehensive plan Geauga County, Ohio. 38 p. + 9 tables + 3 figures.

The purpose of this report is to evaluate all sewer and water facilities in Geauga County and to determine their optimum location, extent and characteristics. A countywide inventory of all existing sewerage and water supply systems has been prepared. These existing systems have been analyzed for adequacy and potential needs of these areas to the year 1990. Future development plans for water and sewer systems have been prepared and presented in this report.

85. Barrientos, C. S. 1971. An objective method for forcasting winds over Lake Erie and Lake Ontario. Internat. Assoc. Great Lakes Res. Proc. 14th Conf. Great Lakes Res. p. 401-411.

An objective method for forecasting surface winds over Lake Erie and Lake Ontario is presented. The developmental data consisted of 1000mb geostrophic wind and sea-level pressure forecasts from the Subsynoptic Advection Model for eight United States cities near the two lakes, as well as marine observations made by anemometer equipped vessels during the 1968 boating season. Two sets of regression equations for forecasting wind speed were derived by applying screening regression. The first yields wind speed by vectorial addition of two directional components; the second yields wind speed directly. Comparison of the two methods further verifies that wind speed forecasts made by combining components are negatively biased. The resulting operational program is described, and verifications based on the 1969 observations are discussed.

86. Barry, D. E. and R. D. Koczaja. 1970. Stream survey evaluation report, 1970. Erie County Dept. of Health. Buffalo, New York. 97 p.

The rapid growth of Erie County in recent years has affected the conditions of its surface waters. But the increased demands on the streams have been met. This is the one outstanding conclusion of the stream survey undertaken in 1970 by the Erie County Department Division of Environmental Health. The effect of contaminants has been lessened by pollution control activities within Erie County. Improved sewage treatment facilities and the construction of new facilities to handle a greater percentage of the population has decreased the demand placed on the streams. The study indicated that with proper waste treatment and the efforts of a well-informed citizenry, the streams of Erie County can be utilized without being destroyed.

87. Bartsch, A. F. 1970. Accelerated eutrophication of lakes in the United States: ecological response to human activities. Env. Pollution. 1:133-140.

Whatever the natural rate of eutrophication may be, the influences of human cultural activities typically accelerate the process, often leading to drastic disturbances of freshwater ecosystems and highly undesirable results. Various known actions may lead to rearrangement of plant nutrients in the environment or to making them far more easily accessible than is normal for biological use and processes. Notable sources of nutrients or bases of change are municipal sewage and urban drainage, select indusrial wastes, rural lands with their agricultural uses, and atmospheric precipitation. The most promising remedial approaches will be those which curtail the nutrient input to the system.

88. Bayer, M. B. 1974. Nonlinear programming in river basin modeling. Water Resources Bull. Water Resources Assoc. 10(2):311-317.

This paper explores the use of nonlinear programming in river basin water quality modelling. Applications recently reported in the literature, along with the author's experience with nonlinear programming, are reviewed. Results obtained using nonlinear programming are compared with the results obtained by other researchers using linear and dynamic programming to solve river basin water quality optimization problems. These water quality models have objective functions with continuous first partial derivatives, several inequality and variable bound constraints, and are of the form:

$$\text{minimize} \quad \sum_{j=1}^{j=n} Y_j(X_j)$$

$$\text{subject to} \quad \sum_{j=1}^{j=n} a_{ij}X_j \geq b_i, i=1,2,\ldots,m$$

$$c_j \leq X_j \leq d_j, j=1,2,\ldots,n$$

The variable X_j is the maximum allowable ratio of the BOD (biochemical oxygen demand) of the effluent outflow to the BOD of the wastewater inflow for treatment plant j, in the range c_j to d_j. The a_{ij} and b_i are constants in the DO (dissolved oxygen) and BOD constraints. The results show, given certain assumptions about the data, that nonlinear programming is a better solution method for these problems than is either linear programming or dynamic programming.

Beeton, A. M. - See: J. E. Gannon, No. 252.

89. Beeton, A. M. 1961. Environmental changes in Lake Erie. Trans. Am. Fish. Soc. 90(2):153-159.

Comparison of data compiled during the past 60 years with those from recent studies shows that major changes have occurred in the bottom and fish faunas of Lake Erie. The bottom fauna was formerly dominated by the nymphs of Hexagenia, but at present midge larvae and oligochaetes are most abundant. Blue pike (Stizostedion vitreum glaucum) and cisco (Coregonus artedii), which formerly dominated the commercial catch, are scarce, while other species are more plentiful than formerly. The concentrations of various major ions have increased as much as 10 p.p.m. The mean annual water temperatures are approximately 2° F. warmer today than during the 1918-28 period. Low levels of dissolved oxygen have been observed several times since 1930, and recently very low concentrations were found in the bottom waters covering many square miles of the central basin. Although similar conditions may have existed in the past, it appears that greater areas are involved at the present.

90. Beeton, A. M., J. W. Moffett and D. C. Parker. 1969. Comparison of thermal data from airborne and vessel surveys of Lake Erie. Internat. Assoc. Great Lakes Res. Proc. 12th Conf. pp. 513-528.

A study of the applications of airborne infrared equipment for detecting water masses and currents of the Great Lakes is described. Infrared scanners were used to make thermal strip maps and an infrared radiometer was used to obtain surface temperatures of the western end of Lake Erie and the lower Detroit River. Simultaneously, surface water temperatures were taken and water samples were collected for chloride determinations from four vessels making a 4 day synoptic survey of the test area. The remote infrared measurements are compared with shipboard temperature data to evaluate their usefulness in demonstrating thermal structure, water masses, and currents in the test area.

91. Beeton, A. M. and H. B. Rosenberg. 1968. Studies and research needed in regulation of the Great Lakes. Proc. Water Regulation Conf. Toronto, Canada. Paper No. R-5. pp. 311-342.

A greater degree of multi-disciplinary activity will be required in the future in solving Great Lakes problems than has been the case in the past. The reasons are linked to the increasing population pressures and the greater demands on the resource from various and often conflicting interests. The public in both the United States and Canada is showing greater interest in man's impact on his environment. How this relates to studies and research needed in the Great Lakes context requires a broader interpretation of regulation than ordinarily applied in the past. Covered in this paper are proposed areas of study that will require the attention of engineers, economists, biologists, sociologists, lawyers, and others in the years to come.

Bellaire, F. R. - See: D. L. Jones, No. 339.

92. Bennett, J. R. 1971. Thermally driven lake currents during the spring and fall transition periods. Internat. Assoc. Great Lakes Res. Proc. 14th Conf. Great Lakes Res. pp. 535-544.

A numerical model is used to study thermally driven lake currents during a period when only part of a lake is stratified. The model predicts that the motion is confined largely to the stratified region. There, a geostrophic current parallel to the shore is the dominant feature. A smaller circulation, with upwelling in the shallow regions and a broad zone of sinking motion centered about the 4°C isotherm, is found to be important in redistributing the heat gained through the surface.

Benninghoff, W. S. - See: A. L. Stevenson, No. 527.

Berg, D. W. - See: J. H. Balsillie, No. 79.

93. Berg, D. W. 1965. Factors affecting beach nourishment requirements at Presque Isle Peninsula, Erie, Pennsylvania. Univ. Mich. Great Lakes Res. Div. Proc. 8th Conf. Great Lakes Res. Div. Pub. 13:214-221.

Analysis of available data on Presque Isle Peninsula, Erie, Pennsylvania, indicates apparent correlation of initial high erosion rates of placed beach fill with sand size characteristics of the fill and the mean level of Lake Erie for the period over which measured losses occur. Although erosion of the fill has been more than anticipated, the data

indicate that nourishment requirements for replenishing the beaches, should decrease as the beach profiles become re-adjusted through selective sorting of the fill material to incident wave forces reaching the peninsula.

94. Berg, D. W. and D. B. Duane. 1968. Effect of particle size and distribution on stability of artificially filled beach Presque Isle Peninsula Pennsylvania. Internat. Assoc. Great Lakes Res. Roc. 11th Conf. on Great Lakes Res. pp. 161-178.

Presque Isle Peninsula, a sandy spit on the south shore of Lake Erie, has experienced continued erosion of its lakeside shoreline ever since first attempts to stabilize and halt its natural eastward migration. For nearly 150 years numerous structures have been built on the shoreline in attempts to slow down or halt the deterioration and migration of the Peninsula and consequent loss of valuable land.

In 1965, approximately 1.27×10^4 m^3 of sand fill, coarser than fill previously used as well as coarser than that which naturally existed on the Peninsula, was placed on a section of the beach; subsequently annual data collection surveys were made in the fill area and in or adjacent parts of the Peninsula.

Analysis of the data indicate the test area involving coarse sand fill has undergone minimal material loss and maintained a relatively stable profile. On the basis of this experiment it is judged that definite shore stabilization occurs, with attendant benefits such as substantially reduced nourishment requirements, from the utilization of sand fill that has size characteristics superior to that originally found on an eroding beach.

95. Berg, D. W. and G. M. Watts. 1965. Variations in groin design. In: Coastal Eng. Santa Barbara Specialty Conf. pp. 763-797.

A brief review of groin types and their respective functional designs is presented. Illustrative examples of conventional groins and some of the variations in the basic groin types, which have been constructed in the U.S. are shown for comparative purposes.

96. Berg, D. W. & G. M. Watts. 1967. Variations in Groin Design. J. Waterways and Harbors Div. Proc. ASCE. Proc. paper #5241. 93(WW2):79-100.

Considering all types of structures utilized for shore protection purposes, the groin is probably the most widely used and yet it is perhaps the one structure least understood. Groins or groin systems of a particular design may be found to have achieved their intended purpose; however, it is not uncommon to learn of other cases where a similar design was used and negligible benefits resulted. Basically, the function of a groin is to build or maintain a protective beach by trapping littoral drift (beach materials) or to retard the erosion of an existing beach. A lack of understanding of all the factors affecting the functional and structural design of groins has led to seemingly endless variations in groin design. This lack of understanding is directly related to the paucity of established theoretical or empirical relationships between the functional behavior of groins and the environmental factors in which the structures must exist. The writers' purpose is to point out pertinent features of basic types of groins and to illustrate some of the many variations that have been built in the United States.

97. Bergs, A. 1965. Surface waves and subsurface particle movement due to waves. Univ. Mich. Great Lakes Res. Div. Proc. 8th Conf. Great Lakes Res. Div. Pub. 13:291-298.

Surface water waves on Lake Huron have been recorded on a pressure type recorder. Harmonic analysis of six sample sections of the record has been carried out with a mechanical type harmonic analyzer, over a frequency range of 0.0003 to 0.33 CPS. Wave spectra and co-cumulative spectra have been calculated based on this analysis. The significant wave heights compare fairly well with those predicted by the methods of Pierson, Neumann, and James (1955) and Bretschneider (1958). A comparison between visually observed surface waves and the corresponding record from the wave recorder shows a distinct lack of sensor sensitivity for wave heights below one meter. A limited number of observations of wave lengths, velocities, and subsurface water particle movements suggest a distinct departure from classical theory.

Berry, G. T. - See: J. B. Bryce, No. 126.

Berti, A. A. - See: C. F. M. Lewis, No. 374.

98. Bethlehem Review. 1970. We're doing our part to clean up Lake Erie. Bethlehem Steel Corp. Bethlehem, Pa. pp. 16-17.

Waste treatment facilities in Lackawanna plant are reviewed. So far, there is more than 135 million gallons of water treated a day, a little less than half of the plant's daily intake. Most of the remainder is water used to cool equipment and for air conditioning and does not pick up any contaminating material.

Bierly, E. W. - See: G. C. Gill, No. 265.

99. Biguria, G., R. C. Ahlert and M. Schlanger. 1970. Distributed parameter model of thermal effects in rivers. New Jersey Water Resources Res. Inst. Rotgers- State Univ. 18 p.

A critical review has been made of the relations used to predict the effect of temperature on reaeration from the atmosphere and biochemical oxygen demand. An equation presented by Dobbins was selected for the reaeration term based on better correlation with experimental data. Results from a thermal dispersion model were used to calculate local and cross-section average oxygen accumulation rates for comparison with results from a lumped parameter model. The net accumulation rates vary significantly in the lateral position on the cross-section, in the distributed parameter model.

100. Bilder, R. B. 1972. Controlling Great Lakes pollution: A study in United States-Canadian Environmental cooperation. Mich. Law Review. 70(3): 469-556.

United States-Canadian cooperation regarding Great Lakes pollution problems has developed within a special geographical, economic, legal and political context. A brief description of this setting may suggest the significance of these pollution problems and some of the reasons for particular form this cooperation has taken. This report briefly states the questions posed to the Commission about pollution in the boundary waters their causes, extent, and remedial measures. Solutions are given in view of law and treaty between two countries.

101. Birchfield, G. E. 1967. Horizontal transport in a rotating basin of parabolic depth profile. J. Geophys. Res. 72:6155-6164.

Horizontal transports in a rotating parabolic basin are found for three elementary steady stress fields. For a uniform stress, the circulation consists of two vortices so arranged that the inshore transport is more or less in the direction of the surface stress, with a return flow in the interior. For a stress with constant curl, the interior transport is a large symmetric vortex with possibly a weak countercurrent near the shore; for a stress with constant curl, the interior transport is a large symmetric vortex with possibly a weak countercurrent near the shore; for a stress with constant divergence, a weak vortex occurs in the interior, combined surface stress, the transport in the interior is dominated by the curl component; near shore the uniform stress component may be equally important. (UB)

102. Birchfield, G. E. 1969. Response of a circular model Great Lake to a suddenly imposed wind stress. J. Geophys. Res. 74(23):5547-5554.

In a recent paper G. T. Csanady (1968) calculated the response of a two layer model lake of constant total depth and circular boundary to a suddenly imposed spacially uniform wind stress. Lateral and bottom are ignored. As a result of this, they seriously alter the conclusions. The purpose of the present paper is to point out several errors in G. T. Csanady's paper and to present the corrected solution and conclusion. (UB)

103. Black, H. H. and L. F. Oeming. 1951. Sewage and Industrial wastes in the Lake Huron-Lake Erie section of the international boundary waters. Part 2, U.S. Section. Sewage and Industrial Wastes. 23(4):517-535.

This section briefly describes the industrial waste program conducted as a part of this survey. It also explains pertinent factors having bearing on the industrial pollution constituents studied. Summary on the results of two special studies is provided. The progress in pollution control during the survey period and outlines of continuing programs are given at the end. (BECPL)

104. Black, H. H. and E. Devendorf. 1954. Industrial pollution of international boundary waters along the Niagara Frontier. Sewage and Industrial Wastes. 26(10):1259-1285.

This report presents a comprehensive discussion on the boundary waters and principal pollution sources. Significant pollutional materials discharged to the boundary waters include untreated or partially treated domestic sewage, industrial wastes, intermittent release of sewage, industrial wastes, intermittent release of sewage from both freight and passenger vessels and the leaching from dredge dumps. Waste control and treatment are also reviewed.

105. Blanton, J. O. and A. R. Winklhofer. 1971. Circulation of hypolimnion water in the central basin of Lake Erie. Internat. Assoc. Great Lakes Res. Proc. 14th Conf. on Great Lakes Res. pp. 788-798.

Hypolimnion water temperature and currents were monitored in the central basin of Lake Erie. A semi-permanent tilt to the thermocline was clearly associated with the dominant southwest winds. The thermocline was shallowest along the Canadian coast.

Fluctuations in the southwest wind component correlated with fluctuations in thermocline positions and with current speeds in the hypolimnion. Peak southwest winds caused increased flow of hypolimnion water toward the Canadian coast.

Coastal upwelling regions whose areal extent have been well documented can account for a large portion of the net flow toward the Canadian coast. We estimate that about 4×10^3 m^3/sec of hypolimnion water can be transported northwestward and upwelled at the coast during typical southwest wind conditions. Only a 200 km^2 upwelling area is required to mix this water with epilimnion water.

106. Blum, J. L. 1965. Interactions between Buffalo River and Lake Erie. Univ. Mich. Great Lakes Res. Div. Pub. 13:25-28.

The Buffalo River is essentially a series of dredged and navigable meanders within the limits of the City of Buffalo, New York; it is formed by the far eastern end of Lake Erie. Pollution from steel, refining and chemical industry is severe in the upper portion of the basin. The river is lined on both banks by industries or abandoned buildings and is an eyesore at many points. However, the river empties into Lake Erie close to the source of a major North American resource, the Niagara River, and concern for the pollution of the Buffalo River is based partly upon possible effects on areas downstream from the river itself.

The present study was undertaken in 1963 and 1964 in an attempt to assess the influence of Buffalo River on the portion of Lake Erie between the mouth of the Buffalo River and the source of the Niagara River. Both physico-chemical and biological parameters were studied, but the present report concerns only certain physical phenomena pertinent to the movement of water within the basin and in adjoining downstream areas.

107. Board of Water Commissions. 1924. Reports on additional water supply for Detroit and environs. Board of Water Commissions of the City of Detroit and environs. Board of Water Commission. Detroit, Mich. 252 p.

The Board of Water Commissions of the City of Detroit presents in this volume the several engineering reports that have been made in connection with its investigation into the problem of additional water supply for a greater Detroit and its environs. The sources for additional water supply are Lake Huron, St. Clair River, Lake St. Clair, Detroit River and Lake Erie. Proposed projects are outlined. (UB)

Boardman, R. M. - See: G. E. Arnold, No. 69.

108. Bolsenga, S. J. 1968. River Ice Jams--A Literature Review. Corps of Engineers, Lake Survey Dist. Detroit, Mich. Res. Rept. 5-5. 567 p.

This report presents the results of a literature search on ice jam characteristics and methods of prevention and removal. Descriptions of ice jam characteristics range from mathematical to narrative treatments. Methods of prevention and removal range from dusting and thermal pollution to the more widely used blasting. Trends in the use of these techniques are indicated.

109. Bolsenga, S. J. 1969. Total albedo of Great Lakes ice. Water Resources Res. Paper no. 57620. 5(5):1132-33.

Total (0.3-3.0) albedo of various types of ice common to the Great Lakes ranged from 10% for clear ice to 46% for snow ice at solar altitudes ranging from 32 to 40°. Explanations are given for similarities between the albedo of pancake (31%) and slush curd ice (32%), and slush (41%) and brash ice (41%). 6 references. (UB)

Borton, T. E. - See: T. R. Lee, No. 371.

110. Braidech, M. M. 1931. Cleveland use Ammonia-Chlorine to check phenol tastes in water. Water Works J. 84(4):433-434, 454, 457-458.

Process lends itself to intermittent seasonal treatment and it is recognized as one of the most practical and economical measures for taste and odor prevention. (BECPL)

111. Brant, R. A. and C. E. Herdendorf. 1972. Delineation of Great Lakes estuaries. Internat. Assoc. Great Lakes Res. Proc. 15th Conf. on Great Lakes Res. pp. 710-718.

The arms of the lakes that extend landward have evaded description and recognized distinction. For the most part such linear bodies of water have been referred to as rivers to some indistinct proximity to the lake. Resulting confusion has led to misunderstandings by public, legal and scientific interest.

This study's approach to the generically related extensions

of the lake is to treat these bodies of water physically and hydraulically and in this context to show these fundamental earth factors to be the essential characteristics of estuaries and that this term may be logically and usefully applied in the Great Lakes.

The physical approach is in consonance with the general application of the term and the use of the concept and term would provide a more definite basis for limnological, biological, geological, and legal considerations.

Lake Erie examples are the basis for the conclusions drawn, but more general application is anticipated. The estuaries extend to as far as 25 km from what may be termed the estuary mouth. Correlation is shown in a gross way by examination of lake survey charts and large scale topographic maps. More detailed lake level relationships are shown by use of hydrographic and water quality records. (Key words: Cuyahoga River; estuary; Great Lakes; Lake Erie; Maumee River; water law; water levels).

112. Brater, E. F. 1959. Methods of correcting wave problems in harbors. J. of Waterways and Harbors Div. Proc. A. S. C. E. Proc. Paper 2299. 85(WW4):39-55.

The causes of and some of the cures for objectionable wave conditions in harbors are discussed. The use of hydraulic models to determine methods of reducing wave action is illustrated by means of examples. Various methods of solving the wave problems which existed in four harbors are described.

113. Braun, R. E. and J. A. Jones. 1970. Thermal loading in Dunkirk Harbor. Lake Erie Environmental Studies. State Univ. College Fredonia, New York. Tech. Data Rept. No. 5. 12 p.

Thermal loading due to warmed effluents from a power plant located on Dunkirk harbor has been investigated over a 14-month period, primarily during 1969. Temperature anomalies of more than 3° C were found to exist in the harbor year-round. Greatest anomalies (more than $5^{\circ}C$) occurred in March, smallest anomalies in April. The harbor basin was noted to be capable of dissipating the heat added by the power plant. Little effect could be found outside the confines of the harbor. Some undetermined combination of factors seemed to control thermal loading in the outer harbor.

114. Brebner, A. 1964. Determination of design waves for the Great Lakes. Univ. Mich. Great Lakes Res. Div. Proc. of the 7th Conf. Great Lakes Res. Div. Pub. 11:322-325.

For any particular coastal location there are two fairly distinct methods of forecasting or calculating the most likely maximum wave-height (μH_{max}) or the significant wave-height (H_s). These are as follows:

a) Wave-heights are actually measured by some device in the water and extreme value statistics, sometimes in conjunction with long-term meteorological data, used to predict μH_{max} or H_s from short-term records.

b) Semi-empirical, e.g. the P.N.J. or S.M.B. (B.E.B. 1961), relationships between fetch (F), wind-speed (U) and duration (t), in conjunction with long-term meteorological data, are used to assess the probabilities of encountering any particular value of H_s. A further statistical distribution relationship is used to obtain μH_{max} from this H_s.

These methods are now discussed more fully as applicable to a particular location on Lake Ontario, namely Cobourg.

Breithanpt, W. H. - See: O. Holden, No. 308.

Brinkhurst, R. O. - See: T. R. Lee, No. 371.

115. Britt, N. W. 1955. Stratification in western Lake Erie in summer of 1953: Effects on the Hexagena (Ephemeroptera) population. Ecology. 36(2):239-244.

Unusually low wind velocities prevailed in the Bass Islands region through the month of August and the first few days of September, 1953. The near calm conditions were especially pronounced during the period August 20 to Sept. 3. Associated with this unusually calm weather were clear skies and high temperatures in some cases exceeding the all time records. In this paper it was shown that these conditions resulted in high water temperature and oxygen deplection near the bottom. This condition, in turn, resulted in changes in the bottom fauna.

116. Brown, F. R. 1972. Engineering and research to support the Corp's mission in the Great Lakes. Proc. 1st Federal Conf. on the Great Lakes. Interagency Committee on Marine Sci. and Eng. pp. 120-130.

Current engineering and research efforts are concerned with the development of efficient and economical small boat harbors located throughout the Great Lakes, improvement of navigation on the St. Clair and St. Lawrence Rivers, effects of cooling water discharge from nuclear and conventional steam plants, improved dredge spoil practices for more efficient utilization of dredged material to protect and enhance the environment, and the effect of offshore construction on mass circulation patterns. More specifically, projects concern the development of the Hamlin Beach Harbor on Lake Ontario, Improvement of navigation in the Cornwall Reach of the St. Lawrence River, and the determination of the effect on adjacent shorelines of the construction of a large offshore jetport in Lake Erie. The latter work is being conducted for the Lake Erie Regional Transportation Authority and is financed in part by a Federal Aviation Administration grant and local funds. The dredge spoil disposal study is a Corps-wide study and is one of the highest priority projects under way.

Future engineering and research to be accomplished at the Waterways Experiment Station within the next few years involve Ludington Harbor on Lake Michigan, Little Lake Harbor on Lake Superior, and Cattaraugus Creek which discharges into Lake Erie.

117. Brown, R. A., R. L. Peace, Jr. and G. E. McVehil. 1967. A study of hydrologic and energy budgets of Lake Erie with emphasis on evaporation measurement. Calspan (formally Cornell Aeronautical Laboratory, Inc.). Buffalo, New York. Cal Report No. RM-2342-0-3. 36 p.

This report contains a summary and comparison of previous tabulations of components in the hydrologic and energy budgets of Lake Erie. A fairly detailed analysis is given for each of the possible methods of determining the evaporation component. Sources of error in current techniques are pointed out, and where possible, the probable errors are estimated. Promising new approaches, or needed studies of particular problems, are noted. (UB)

118. Browzin, B. S. 1966. Annual runoff in the Great Lakes-St. Lawrence Basin. Univ. Mich. Great Lakes Res. Div. Pub. 15:203-219.

The annual runoff in the Great Lakes-St. Lawrence basin, expressed in terms of unit runoff, increases from the southwest to the northeast approximately six times, which is an unusual characteristic of a river basin. The responsible factors, precipitation and its seasonal distribution, as well as mean annual temperature vary considerably but not gradually from the Middle West portion of the basin to the coast of the Atlantic. Frequency analysis based on available data at gaging stations located in various climatic zones of the basin has shown that the frequency distribution of the annual runoff is moderate to low as compared with other basins with similar geographic conditions.

119. Bruce, J. P. 1970. Water pollution and the role of the Canada Centre for Inland Waters. Canadian Geographical J. June, 1970. pp. 182-193.

General pollution problems are discussed. It covers bacterial contamination, excess nutrient inputs, oil pollution, thermal waste and industrial wastes. Programs conducted by the Canada Centre of Inland Waters are described.

120. Bruce, J. P. 1972. Meteorological aspects of Great Lakes pollution. Canada Center for Inland Waters Branch. Burlington, Ont. Reprint No. 171. 6 p.

Pollution of the waters of the Great Lakes system has become a matter of major concern to the thirty-five million Canadian and U. S. residents of the Great Lakes Basin. It has also become an international symbol of the extent to which man's technological society can seriously affect very large natural systems if appropriate controls and waste treatment measures are not undertaken. Fortunately, governments at federal, state, and provincial levels in both Canada and the United States now recognize the problems and the need for determined action and expenditures of large sums of money for their solution although many members of the scientific community and the public feel that pollution abatement progress is still two slow, especially on Lake Erie. This note outlines the major pollution problems affecting the Great Lakes and indicates how meteorological factors bear on the study and solution of these problems.

121. Bruce, J. P., D. V. Anderson and G. K. Rodgers. 1961. Temperature, humidity and wind profiles over the Great Lakes. Univ. Mich. Great Lakes Res. Div. Pub. 7:65-70.

This preliminary report on measurement of temperature, humidity and wind profiles by means of the new meteorological boom on the research vessel, Porte Dauphine, suggests that considerable effort must yet be put forward to convert the readings into reliable profiles. The data presented indicate that while inter-calibration problems are avoided by taking the observations with the same instrument at each level, the time between observations at low levels and higher levels, of two minutes or so, may significantly distort the results under gusty wind conditions and with an unstable air mass. In addition, the "windage" effect of the ship, while small, will have to be determined before the profile results can be considered reliable. However, mean profiles under conditions of neutral stability were found to yield values of drag coefficient not radically different from those of other investigators, so that it appears likely that the boom will be a valuable tool in obtaining profiles under conditions of light to moderate winds and stable to slightly unstable lapse rates. The main value of the instrument will be an operational tool to determine the low level "climatology" of air masses over the lakes.

122. Bruce, J. P., R. K. Lane and H. S. Weiler. 1968. Processes at the air-water interface. Internat. Assoc. Great Lakes Res. Proc. 11th Conf. on Great Lakes Res. pp. 268-284.

Some of the significant recent work on interactions between water and air, with special reference to the Great Lakes, is summarized. Macro- and meso-scale aspects of air mass modification by large lakes are discussed, as well as studies concerning wind fields over lake and other large-scale effects of weather on lake systems. On the micro-scale, a review is presented of the various measured values of drag coefficients, similarity considerations in the boundary layer are discussed, and some research problems in momentum exchange processes and turbulent motion are outlined. In connection with radiant energy exchanges, the importance is emphasized of an understanding of the characteristics of reflected and emitted radiation in interpreting observations by remote sensing, such as infra-red imagery. Measurement and interpretation of light extinction in lake waters are also discussed.

123. Bruce, W. A. and I. Grossman. 1970. Oil--A statewide pollution problem. Div. of pure waters New York State Dept. Health. 10 p.

One of the most publicized and controversial types of pollution is that caused by oil and other petroleum products. Whereas, wastes from municipalities and industries can be successfully collected, treat and rendered harmless before discharge to streams, the multitude of small spills or releases of petroleum products occuring yearly cause property damage, impair water quality and destroy wildlife. This paper discusses the efforts initiated in New York to cope with oil pollution and briefly mentions the national and international aspects of the problem.

124. Brunk, I. W. 1963. Additional evidence of lowering of Michigan-Huron levels. Univ. Mich. Great Lakes Res. Div. Great Lakes Res. Div. Pub. 10:191-203.

The water level of Lake Michigan-Huron has decreased more than 1.5 ft. relative to Lake Erie since the 1880's. Brunk (1961) attributed this to downcutting of the channel connecting Lake Huron and Lake Erie. Lawhead (1961), in a lengthy discussion of Brunk's paper, concluded that no more than half of the reduction was due to downcutting, and that a similar amount should be attributed to changes in the precipitation pattern between the test periods, 1878-1887 and 1946-1955. The quality of much of the data has improved significantly since the early period (Brunk 1962). A comparison of the relations between precipitation, net basin supply, and discharge from several of the Great Lakes, based on more recent data, is used in the present paper to show that there are discrepancies between the modern data and that of the last century. These comparisons suggest that the quality of the discharge data from Lake Erie in the last century is only slightly inferior to modern data, but that the discharge values give for M-H are excessive by significant amounts in many years prior to about 1900. A re-examination of the precipitation estimates for the early period suggests that the estimates for the M-H watershed were also too large during the early years. These finding support the conclusion of Brunk (1961) that most of the decrease in the levels of M-H was due to downcutting of the outlet channel of M-H.

125. Brunk, I. W. 1964. Hydrology of Lakes Erie and Ontario. Univ. Mich. Great Lakes Res. Div. Proc. 7th Conf. Great Lakes Res. Div. Pub. 11:205-216.

A study of the hydrologic characteristics of the Erie and Ontario basins indicates significant differences. In the Erie basin only about 1/3 of the precipitation becomes streamflow--apparently the lowest proportion for any of the Great Lakes basins. In the Ontario basin the streamflow is equivalent to approximately 1/2 of the precipitation. It appears that factors other than climate are responsible for these differences in hydrologic characteristics. There is a large variation among the various river basins which drain into Erie and Ontario, and also in the months of the year, in the percentage of precipitation which flows into the lakes. The monthly extremes for Erie range from 75% in March to only 8% in September. For Ontario the values are 117% in April and 17% in August. The water area of Lake Erie makes little contribution to the total water supply of the Great Lakes, because the average annual evaporation of approximately 34 inches is about the same as the average annual precipitation on the water surface of the lake. The average monthly evaporation from Lake Erie is largest in October--about 6-1/2 inches. For Lake Ontario, the apparent average annual evaporation is between 29 and 30 inches.

Bruno, R. O. - See: J. H. Balsillie, No. 80.

126. Bryce, J. B. and G. T. Berry. 1968. Lake Erie-Niagara ice boom. Eng. J. 51(2):28-35.

Describes the design, construction and performance of the ice boom constructed in Lake Erie at the entrance to the Niagara River in 1964. Principles use in locating and designing the boom came from the successful boom in the international rapids of the St. Lawrence, constructed in 1959. Periodic massive discharge of ice into the Niagara River from Lake Erie, which damaged bridges and disrupted power production, have been controlled during three winters. (UB)

Budd, C. B. - See: G. E. Flower, No. 235.

Budd, C. B. - See: G. E. Flower, No. 236.

127. Buechi, P. J. and R. R. Rumer. 1969. Wind induced circulation pattern in a rotating model of Lake Erie. Internat. Assoc. Great Lakes Res. Proc. 12th Conf. Great Lakes Res. pp. 406-414.

Experimental studies have been undertaken to determine the effects of prevailing westerly wind on the circulation patterns in a vertically distorted Froude model of Lake Erie. The studies were performed in a rotating laboratory that housed the model lake, all necessary instrumentation, and personnel. A vertical scale of 1:500 and a horizontal scale of 1:200,000 were used in the construction of the model.

Wind stresses were simulated using a battery of centrifugal blowers. Model wind velocities would be varied from zero to 13 ft/sec. Preliminary correlation with prototype wind speeds was obtained by measuring water level changes in the eastern end of the model lake and comparing with available prototype field observations for known wind conditions. Motion picture studies, with dyes serving as tracers were used in the collection of data. Comparison with earlier circulation studies performed in the absence of wind stress reveals significant changes in the overall circulation pattern and the appearance of significant differences between surface and subsurface circulation patterns.

128. Buetikofer, L. B. and D. D. Meredith. 1972. Annotated bibliography on Great Lakes Hydrology. Univ. Illinois, Water Resources Center. Urbana, Ill. Research Rept. # 56. 62 p.

This bibliography contains 233 literature references on Great Lakes hydrology. The references are listed alphabetically by author for the following topics: precipitation; evaporation; runoff; lake levels and flows; hydrologic budget; currents, winds, and water temperature; and general.

Bundy, D. - See: J. R. Miner, No. 413.

129. Burger, A. A. 1928. Sewage works construction at Cleveland Ohio. Eng. News-Record. 101(2): 53-58.

Close liaison of design and construction thinking in building the new southerly sewage-works at Cleveland, Ohio, are reported. Developed plant coordination and an orderly construction procedure carried the work through astonishingly free from difficulties. Detail construction procedures of the plant are discussed. (BL)

130. Burger, A. A. 1948. Steel-drum crib for Cleveland Intake. Eng. News-Record. 141(6):76-79.

Features of Nottingham Intake under construction include submerged crib, 10 ft. diameter concrete pipe intake, and 1 1/2 mi. land section of intake (to be built as 10 ft. diameter free air tunnel). Capacity of drum intake will weigh 1100 tons when sunk in final position and ballasted with concrete. Pictorial data on tunneling in hard gray shale is also provided. (BL)

131. Burgess and Niple Limited. 1969. A study of stream pollution from combined sewer overflows and feasibility of alternate plans for pollution abatement in Bucyrus, Ohio. U.S. Federal Water Pollution Control Administration. Washington, D.C. Water Pollution Control Research Series. 11024 FKN 11/69. 197 p.

This report contains the results of a detailed engineering investigation and comprehensive technical study to evaluate the pollution effects from combined sewer overflows on the Sandusky River at Bucyrus, Ohio and to evaluate the benefits, economics and feasibility of alternate plans for pollution abatement from the combined sewer overflows. Various methods of controlling the pollution from combined sewer overflows are presented along with their degree of protection, advantages, disadvantages, and estimates of cost. The method presented include (1) complete separation (2) interceptor sewer and lagoon system (3) stream flow augmentation (4) primary treatment (5) chlorination and (6) off stream treatment. It was concluded that the most economical method of providing a high degree of protection to the Sandusky River is by collecting the combined sewer overflows with a large intercepter and using an aerated lagoon system to treat the waste loads from the overflows. (UB)

132. Burkholder, J. A. 1973. Natural resources management in the Great Lakes Basin. The New York State Sea Grant Program. Albany, N.Y. 170 p.

Discussion of programs that are designed to yield effective management of the water and related land resources of the Great Lakes Basin. Cooperative management between the U.S. and Canada are concerned with lake level control, navigation, and water quality.

Byrd, J. F. - See: R. G. Ostendorf, No. 444.

133. Cameron, A. B. 1932. Erie Sewage Treatment Plant design and preliminary results of operation. Sewage Works J. 4(5):800-814.

This paper deals mainly with the operation and tuning up processes of the Erie, Pa., Sewage Treatment plant. This plant can treat sewage of city having population of over 116,000. Quality and quantity of sewage, plant interceptor, bar rack, incineration design, digestors, detritors, gas production, sludge disposal of the plant have been discussed. The discussion section of this paper is given by J. T. Campbell, consulting engineer in Pittsburgh, Pa. (UB)

134. Canada Centre for Inland Waters. Undated. Annual Report-1968. Dept. Energy, Mines and Resources. Fish. Res. Board. Dept. Nat. Health and Welfare. Burlington, Ont. 30 p.

Programs conducted in the Canada Centre for Inland Waters in the year of 1968 are discussed. Studies involved are: physical limnology; limnogeology; engineering services; computer data services; etc. No data or reports are given.

135. Canada Centre for Inland Waters. 1970. Annual Report-1969. Dept. Energy, Mines, and Resources. Fish. Res. Board. Dept. Nat. Health and Welfare. Burlington, Ont. 40 p.

Highlights of some important developments that occurred at the Center in 1969 were reviewed. Studies made in Lake Erie included core sampling, Lake Erie Time Study project, etc.

136. Canada Centre for Inland Waters. 1971. Canada Centre for Inland Waters, 1970. Dept. Fish. and Forestry. Burlington, Ont. 53 p.

Programs conducted in Canada for Inland Waters in the year 1971 are discussed. Studies include biological limnology, chemical limnology, limnology, physical limnology, microbiology, engineering services, laboratory services, computer and data services; etc. No data or reports are given. Transportation processes were studied on western Lake Erie.

137. Canada Centre for Inland Waters. 1972. Canada Centre for Inland Waters-1972. Dept. Environment. Burlington, Ont. 125 p.

Highlights of activities in 1972 were reviewed. In Lake Erie the high lake levels were studied. Shoreline studies as well as pollution were also included.

138. Canada-United States University Seminar, 1971-1972. 1973. A proposal for improving the management of the Great Lakes of the United States and Canada. Univ. Waterloo. Waterloo, Ont. 76 p.

During the period, December, 1971, to June, 1972, faculty members from some twenty universities and colleges in Canada and in the United States joined in a dialogue to explore ways in which the institutional structures for the management of the water and land resources in the Great Lakes Basin might be strengthened to the mutual advantage of both countries. Topics covered are water quality, fish, and wild life, lake level control, navigation, and urban and industry land use. Four recommendations are proposed to both governments.

139. Canadian Marine Transportation Administration. 1971. Winter Navigation studies Lake Erie, Detroit River, Lake St. Clair, St. Clair River, Winter 1970-1971. The St. Lawrence Seaway Authority, Ministry of Transport. Canadian Marine Transportation Administration. 143 p.

During the winter of 1970-1971 the Canadian Marine Transportation Administration, Ministry of Transport expanded upon an extensive overall investigation with a view to extending the navigation season on the St. Lawrence River and Great Lakes. As part of the overall project, a study programme was carried out on Lake Erie and the Detroit-St. Clair River's system. This report presents the results of observations and analysis of the investigations undertaken with conclusions and preliminary recommendations regarding future studies in these areas. (UB)

Carbaugh, H. C. - See: G. E. Arnold, No. 69.

140. Carlson, Richard E. 1971. Lakeshore physiography and use. Limnos. 4(2):3-14.

A map of Lake Erie is provided showing generalized shore use and shore types. The land use and ownership shown in tabulations and on the map is that of the existing riparian land along Lake Erie shoreline.

141. Carr, J. F., V. C. Applegate and M. Keller. 1965. A recent occurrence of thermal stratification and low dissolved oxygen in western Lake Erie. Ohio J. Sci. 65(6):319-327.

Instances of thermal stratification have been detected only occasionally in western Lake Erie during the past 40 years, but when it does occur it is of considerable importance because of associated dissolved oxygen (DO) depletion in the hypolimnion. Data collected in June of 1963 give an indication of the meteorological conditions necessary to produce this thermal stratification. These conditions are: daily wind speed of less than 3.1 m/sec (7 mph); highest wind speed of less than 6.7 m/sec (15 mph); and an average daily temperature of more than 18.5 C for approximately 5 consecutive days. Weather records for Sandusky, Ohio, show these conditions to have occurred on 33 separate occasions between 1953 and 1963. These data suggest stable thermal stratification occurs more frequently than heretofore suspected. The 1963 data also show that in only 5 days of stratification DO in the hypolimnion was reduced to less than 3 ppm, whereas 28 days were required in 1953. This increased rate of DO depletion is probably due to an increase in the oxygen demand of the bottom sediments in recent years.

142. Charlier, R. H. 1970. Pollution, oceanology, and limnology in the Great Lakes. Marine Tech. Soc. J. Paper 09071. 4(3):59-68.

The nature and scope of the problem of pollution of the Great Lakes is reviewed and measures to control pollution are examined. Specifics are given for: programs of oceanography and limnology at Great Lakes universities; governmental activities at the state, national and international levels; Great Lakes research programs; sources of pollution; and recommendations for future action in research studies and practical measures. 47 references. (UB)

143. Chase, P. E., J. L. Baker and E. W. Lewis. 1970. Ice data collection and usage: Emphasis on prediction techniques. Internat. Assoc. Great Lakes Res. Proc. 13th Conf. on Great Lakes Res. pp. 790-797.

This study is an output from a 2 year effort aimed at developing analytical techniques, system concepts, and evaluation experience applicable to fostering systems for collecting and managing data on earth resources. This is a special report limited to a review of ice prediction method with suggestions for developing ice prediction techniques for the Great Lakes. The system of ice data collection, processing, and use was studied to place prediction in the proper context. Adequate prediction techniques are not available; indeed, description of ice conditions is neither complete nor timely enough for users with urgent needs. This lack of applicable information does not lie with any one government agency or even with the agencies en masse. Rather, sufficient scientific and operational study has not been expended. An increase in such study effort is suggested in the belief that major improvements in data gathering and management are possible through a paced systematic effort.

144. Cheng, R. T. and C. Tung. 1970. Wind driven lake circulation by the finite element method. Internat. Assoc. Great Lakes Res. Proc. 13th Conf. on Great Lakes Res. pp. 891-903.

A simple mathematical model for lake circulation which includes wind stress, bottom friction, Coriolis force and the actual shore line of the lake is presented. Special attention is focused on the geometrical effect of the lake on the circulation patterns. The lake is assumed to be of constant depth but with arbitrary lateral topography. The governing equation of a stream function for the mean velocity components takes the form of Poisson's equation. The resulting boundary value problem has been solved for the case of Lake Erie by the finite element method. The finite element method is simple to use in dealing problems with irregularly shaped boundaries. The circulation in Lake Erie caused by in-flow and out-flow is presented along with the circulation caused by wind shear. Discussions of the main results are given based on the mathematical properties of the governing equation.

145. Chieruzzi, R. and R. F. Baker. 1959. Investigation of bluff recession along Lake Erie. J. of Waterways and Harbors Div. Proc. A.S.C.E. Proc. Paper 2302. 85(WW4):109-132.

A systematic approach to the analysis of bluff recession problems is presented. Three inter-related studies are normally required: beach development, toe protection, and stable slope development. An engineered solution to each of the three can lead to efficient stabilization of the bluff. An analysis of a typical problem east of Cleveland is included as an example. (CE)

146. Chittenden, H. M. 1898. Reservoir system of the Great Lakes of the St. Lawrence Basin. Proc. A. S. C. E. 24(6):526-558.

The immense system of inland navigation is discussed. Lake oscillation is observed and analyzed mathematically. Fundamental propositions pertaining to the action of reservoirs in the regulation of stream flow are reported. (BL)

Cho, H. K. - See: J. P. Coakley, No. 152.

Christenbury, G. - J. R. Miner, No. 413.

Churchill, M. A. - See: G. E. Arnold, No. 69.

147. City of Erie, Pennsylvania and Hammer Mill Paper Company. 1969. Joint municipal and semichemical pulping waste treatment. Federal Water Pollution Control Admin. Washington, D. C. Water Pollution Control Res. Ser. ORD-1. 137 p.

The city of Erie, Pennsylvania and Hammer Mill Paper Company made a study of the joint treatment of domestic sewage and pulp and paper making wastes. A pilot plant was constructed and operated in a series of controlled experiments. Supplemental studies were conducted in the Hammer Mill Laboratories including the operation of a bench scale activated sludge plant. It was demonstrated that a joint treatment plant could effectively treat a mixture of domestic sewage and pulp and paper mill wastes from Hammer's Erie Division. (UB)

148. City Planning Board (Buffalo). 1970. Buffalo waterways. A report on the history of the port of Buffalo and related matters. Buffalo City Hall, Buffalo, New York. 62 p.

The report retells the development of the Buffalo Harbor and River area as shaped by historical-economic factors. It recounts engineering feats and design specifications involved in the creation of harbor facilities including the Buffalo River. Fluctuations of the shipping industry and consequent waterfront development are discussed. Current pollution awareness is related to discussion of water quality analysis, surveillance and control measures as of 1970.

149. Clark, O. E. 1940. Construction features of Toledo's new improvements. Water Works Eng. 93(6): 286-289.

Detail descriptions of construction of Lake Erie intake water tunnel and pipe lines are reported. The new system can provide 131 mgd water supply to Toledo, Ohio. (UB)

150. Cleary, E. J. 1938. Cleanup Great Lakes. Eng. News-Record. 121(7):197-201.

Development of sewage disposal at Niagara Falls, Buffalo, Cleveland, and Detroit will relieve Great Lakes of pollution load of 800 mgd. Features of new sewage disposal plant are mentioned. (BL)

Cleary, J. V. - See: G. E. Arnold, No. 69.

Clevenger, R. F. - See: J. W. MacLaren, No. 392.

151. Coakley, J. P. 1972. Nearshore sediment studies in Western Lake Erie. Internat. Assoc. Great Lakes Res. Proc. 15th Conf. Great Lakes Res. pp. 330-343.

Investigations into the distribution and provenance of nearshore sediments deposited along the Canadian shoreline of western Lake Erie were carried out in 1970 and 1971. The study area extended from Wheatley to the Detroit River and off-shore for a distance of approximately 3 km. Data collected included echograms and bottom samples collected along traverse lines perpendicular to the shoreline and spaced at approximately 6 km, although closer coverage was used in the vicinity of Point Pelee and at the Detroit River. In addition to the above data, studies of bed transport using fluorescent tracers were carried out on the shoal south of Point Pelee.

The extremely flat and regular bottom topography of the lake bottom in this area is broken only by the abrupt

rise of the Point Pelee platform, and by the occurrence of bedrock outcrops at Colchester and southwest of the tip of Point Pelee. Irregularities in bottom topography, comprising depressions and trenches, occur on the shoal to the south of the Point and reflect the dredging activity there. Bedrock, ranging in age from upper Silurian to middle Devonian, underlie the area and comprise approximately 6% of the nonmud facies. Glacial material, mostly till, with associated lag deposits comprise the bulk of the bottom sediments exposed (55%). Sand and gravel deposits of considerable aerial extent(39%) occur in the western (Detroit River) and eastern (Point Pelee) ends of the area. The thickness of these sand and gravel deposits is not precisely known, although those on the shoal off Point Pelee appear to exceed 10 m. Soft clayey silt muds predominate in the regions further offshore.

The principal sources of the sandy deposits east of Colchester are the eroding shore bluffs along the north shore of the study area and to the east. The extensive areas of lag materials over the glacial deposits indicate that in situ erosion of these glacial deposits on the bottom also represent a major source of nearshore sediments, especially along the eastern side of Point Pelee. West of Colchester, where shore erosion is less intense, the discharge of sandy materials from the Detroit River and Big Creek represents the major source of the sand deposited in this area. Apart from the section west of Colchester, where net westward movement is inferred, the overall direction of sediment movement is toward the east and southeast, although evidence is strong that near the tip of Point Pelee, this pattern becomes complex and frequent reversals in sediment transport direction occur. The results of the tracer work off the tip of the Point support this contention.

152. Coakley, J. P. and H. K. Cho. 1972. Shore erosion in Western Lake Erie. Internat. Assoc. Great Lakes Res. Proc. 15th Conf. Great Lakes Res. pp. 344-360.

Erosion along the shoreline of western Lake Erie from Wheatley to the Detroit River was investigated by measuring strand line positional changes on aerial photographs taken in 1931. 1947, and 1970. With the exception of the portions west to Colchester, around Kingsville, and the northwestern shore of Point Pelee, erosion is progressing at rates of up to 1.5 m/yr, mostly in areas of bluff

shoreline. At Point Pelee erosion is confined to the western tip and along the eastern side.

In addition to the aerial photograph evidence, which can be regarded as indicative of general, long-term developments, detailed ground investigations were carried out along the shore from Point Pelee westward to Colchester Point. Data on wind and wave parameters, longshore drift, beach materials and beach profiles were collected over a two-month period at six shore stations. Wave refraction diagrams were also constructed on the basis of the predominant wave regime.

Longshore drift, consistently eastward to southeastward in the area from Colchester to Point Pelee, showed reversals in direction at the tip of Point Pelee. Also on the western side of the tip of the Point, local erosion far exceeded figures obtained by aerial photograph comparison, with recession measuring almost 4 m during the three-month survey period.

Rising water levels since glaciation of the area is believed to be responsible for most of the erosion in the bluff shorelines. In the case of Point Pelee erosion, however, alteration in supply of accretionary material through shoreline construction and dredging appear to be significant factors. (Key words: Erosion; Lake Erie; shorelines).

153. Coakley, J. P., W. Haras and N. Freeman. 1973. The effect of storm surge on beach erosion, Point Pelee. Internat. Assoc. Great Lakes Res. Proc. 16th Conf. Great Lakes Res. pp. 377-389.

The passage of a severe storm on 14 November 1972 caused considerable damage to properties situated on the east side of Point Pelee. Most of the destruction was due to the primary effects of three-meter high waves operating concurrently with elevated water levels further aggravated by the storm surge. Although water level gauges at Point Pelee were inundated by the storm surge, it was possible to interpolate the levels, which during the storm exceeded 60 cm above the mean daily level.

Extensive erosion occurred along the approximately 10 km of shoreline studied, with sand and gravel removed from the lower beach face and deposited up to 100 m inland. An estimated 5.5 cubic meters per meter of beach were eroded

from the beach. This westward migration of the beach bar on the east side, with similar buildup on the west side, reflects the overall morphological trend of the Point Pelee landform over the past 200 years.

Cohen, J. M. - See: I. J. Kugelman, No. 353.

154. Cole, A. L. 1967. An evaluation of wind analysis and wave hindcasting methods as applied to the Great Lakes. Internat. Assoc. Great Lakes Res. Proc. 10th Conf. Great Lakes Res. pp. 186-198.

The specification of an appropriate wind field over the Great Lakes is one of the more serious limitations to successful wave hindcasting. Available data consist of wind or pressure measurements along with temperature, humidity, etc. Wind charts may be prepared from the former; however, wind reports from the lakes are rather scarce while those from land stations are often not representative of over-water conditions. The geostrophic and gradient wind approximations constitute standard methods for calculating winds from a pressure field. However, reducing these winds to an anemometer height wind suitable for use in a wave hindcast scheme is a process not well understood at this time. To evaluate the methods now in use, wind and wave hindcasts were made for selected time intervals during 1965 and 1966. For Muskegon, Mich, comparisons have been made between hindcast and observed winds and waves.

The surface winds were determined from the geostrophic and gradient winds by empirical methods utilizing atmospheric stability and wind field curvature. A surface wind field was also deduced from upwind land station reports using empirical results based on stability and fetch. Wave hindcasts were obtained by the semi-empirical techniques of the significant wave height and wave spectra. The surface winds obtained from the geostrophic wind analysis and waves determined by the significant wave height technique correlated best with observed data; however, the correlation coefficients were not highly significant.

155. Cole, A. L. 1968. Objective mesoscale analysis of the surface pressure and geostrophic wind fields of the Great Lakes area. Internat. Assoc. Great Lakes Res. Proc. 11th Conf. Great Lakes Res. pp. 298-312.

Surface wave hindcasting and forecasting, lake current studies, air pollution problems, ice movement investigations and many other areas of research in the Great Lakes region require a knowledge of the surface wind field. The production of such a wind field by an objective pressure analysis and the application of the geotrophic wind assumption is discusses and evaluated. The successive approximation technique (SAT) using a 17 by 18 grid with 75 km grid spacing and about 110 input pressures is used to calculate grid point pressures. The orthogonal components of the geostrophic wind are then readily calculated. The pressure analysis technique was evaluated by comparing measured pressures with those obtained by interpolation from the SAT analysis. Both data used in the analysis and some that were withheld from the analysis were tested with the former showing an error of a few tenths of a millibar and the latter having errors from a half to two millibars. A second evaluation was made by comparing the pressures obtained from the SAT analysis with mean values of several hand analysis performed by students at The University of Michigan and by experienced forecasters at ESSA Weather Bureau and USAF Air Weather Service stations. The objective analysis at the grid points was usually within one standard deviation of the mean values of the hand analyses.

156. Cole, A. L. 1969. Wave forces in Lake Erie. Internat. Assoc. Great Lakes Res. Proc. 12th Conf. Great Lakes Res. pp. 540-552.

Wave forces on the Great Lakes, while obviously important, have received little study so that a field evaluation of existing theories was made at Lorain, Ohio, tentatively and quantitatively confirming Sainflou's theory.

157. Cole, A. L. 1972. Analysis of Lake Erie wave pressure data. Northern Ill. Univ. Dept. Geog. Final Rept. 54586-1. 54 p.

Measured wave heights, wave periods, mean water level increases, and depths of water on a breakwater at Lorain, Ohio, were used to compute pressure profiles on the breakwater during non-breaking wave reflections. These computed pressure profiles were evaluated with wave pressure measurements taken concurrently. The pressure profiles computed according to the Sainflou formulation agreed reasonably well with the experimental profiles except near the still water level where the experimental data

indicated a marked increase of the wave pressures which was not predicted by the theoretical calculations. A second empirical wave pressure profile formulation due to Minikin did not agree as well with the experimental data although its simplicity and its rough agreement with the measured pressure profiles may encourage its use in design problems.

158. Cole, A. L. 1973. Experimental evaluation of wave pressure formations for non-breaking waves. Internat. Assoc. Great Lakes Res. Proc. 16th Conf. Great Lakes Res. pp. 508-516.

Experimental data have been used to evaluate theoretical formulations of the pressures produced by non-breaking waves on a vertical breakwater. The data were obtained in the fall of 1969 in Lake Erie at Lorain, Ohio, and consist of wave pressures at seven vertical positions on the breakwater plus wave heights and water levels as required for the theoretical formulations. Wind speed, wind direction, lake temperature and air temperature were also recorded.

Wave pressure profiles calculated from the observed data using a theoretical formulation by Sainflou showed general agreement with the measured wave pressure profiles except near the still water level. The observed wave pressure profiles showed a marked increase in wave pressure just below the still water level that was not predicted by the Sainflou formulation.

A wave pressure formulation by Minikin did not verify as well, although the deviations from observed values were not excessive. Because it required only the undisturbed wave height as input data and has very simple calculations, the Minikin formulution may well be used for design purposes.

159. Cole, H. S. and W. A. Lyons. 1972. The impact of the Great Lakes on the air quality of urban shoreline areas: some practical applications with regard to air pollution control policy and environmental decision making. Internat. Assoc. Great Lakes Res. Proc. 15th Conf. on Great Lakes Res. pp. 436-463.

Recent studies indicate that the air pollution problems of the urban Great Lakes shorelines are magnified by the mesoscale effect of the lakes on dispersion. Deleterious lake effects are most pronounced during the warm season when stabilized lake air penetrated inland. Onshore flow associated with lake breeze and easterly gradient winds occurs on about 60% of warm season days in the Chicago-Milwaukee area. Several mesoscale regimes promote adverse dispersion phenomena including mixing depth reduction, plume trapping, continuous fumigation and/or recycling of pollutants. During stable onshore flow, lowest mixing deqths occur nearest the shoreline where emissions and people are numerous. Heavy concentration of automobile traffic near the lake may result in pollutant build-up and photochemical smog during stable onshore flow with bright sunshine. Under the same conditions lake-induced fumigation causes excessive pollutant concentration inland from coal-fired shoreline power plants. Trapping of low level plumes is most serious at night or with overcast skies.

The study finds that air pollution control agencies need to incorporate these adverse phenomena in the design of dispersion models and in formulating regulations. Evidence supports the need for reduction of automobile traffic near shorelines. Lake airports and lake freeways will adversely affect shoreline air quality.

160. Condren, A. J. and J. E. Etzel. 1966. Waste treatment by free radical oxidation. Univ. Mich. Great Lakes Res. Div. Proc. 9th Conf. on Great Lakes Res. Great Lakes Res. Div. Publ. 15:380-388.

Fenton's reagent, a combination of hydrogen peroxide and a ferrous iron salt, was studied as a means of chemically oxidizing the organic constituents present in a simulated scondary effluent from a waste water treatment plant. The variables accounted for in the experimental design included: 1) waste strength, 2) concentration of hydrogen peroxide, 3)concentration of ferrous iron, 4) reaction time. All reductions in the organic content of the experimental waste were measured using a modification of the chemical oxygen demand test specifically adapted for determination of low COD values.

The experimental result showed that the reduction of waste concentration was a function of hydrogen peroxide, ferrous iron and reaction time. It was also noted that the percent

reduction in waste strength was a function of the initial waste concentration, a higher percentage removal being obtained with lower waste concentrations. An empirical relationship employing a one-hour reaction time has been derived relating the amounts of hydrogen peroxide and ferrous iron to be added to a specified strength of waste water to insure maximum oxidation of organic material

The empirical relationship was found to be:

$$X_1 = 0.005524\ X_3^2 + 0.700414\ X_3$$

$$X_2 = 0.280\ X_3$$

$$Y = -0.00132\ X_3^2 + 0.61407\ X_3$$

where

Y = COD removed, mg/l

X_1 = hydrogen peroxide concentration required for optimum COD destruction, mg/l

X_2 = ferrous ion concentration required for optimum COD destruction, mg/l

X_3 = initial wastewater COD, mg/l

Connor, A. J. - See: O. Holden, No. 308.

Connor, D. - See: T. R. Lee, No. 371.

Connor, R. D. - See: R. H. Smith, No. 517.

161. Consaul, F. I. 1909. Construction of a concrete block sewer in Toledo, Ohio. Eng. News. 61(5):123-124.

The complete work of constructing a reinforced-concrete block for a main sewer in the city of Toledo is reported. Details of sewer concrete block design are given. (BL)

162. Cooley, L. E. 1896. Report on technical work. In: Report of the U.S. Deepwater Ways Commission. 54th Congress, 2nd Session. House of Representatives Document No. 192. pp. 43-46, 107-109.

The detail map shows the available depth of water through the passage between Huron and Lake Erie through Lake St. Clair and the Detroit River. The map for Lake Erie and Lake Ontario through the Niagara River and proposed ship canal and Welland Canal is also provided. Water level tables for the Great Lakes are recorded. Effects of gales on Lake Erie are discussed. (UB)

163. Copeland, R. 1971. The Mercury treat: Questions to consider. Univ. Mich. Great Lakes Res. Div. Collected reprints. 3:284-287.

Mercury is an element which has up to now received little study in the environment. Very little is known about its geochemical behavior, and studies into its distribution are just beginning. Nevertheless, the problems posed by its presence in Lake St. Clair and Lake Erie can at least be outlined and some preliminary hypotheses proposed. Three questions need to be considered: 1) How and in what chemical form is mercury entering the lake environment 2) How does mercury become incorporated into the plants and animals 3) If mercury inputs are stopped, how long will mercury remain at a hazardous level in the lake environment?

164. Cornell Aeronautical Laboratory, Inc. 1972. Assessment of the environmental effects accompanying upland disposal of polluted harbor dredgings, Ashtabula Harbor, Ohio. (Appendix A-Supporting data and calculations). Cornell Aeronautical Lab Inc. Buffalo, New York. Tech. Rept. Cal. No. NC-5191-M-2. 25 p.

Upland disposal of polluted harbor dredgings from Ashtabula Harbor, Ohio, is discussed. Comparison of pollutant loadings by direct lake dumping and river discharges is made. It is clear that pollutant loadings can be greatly reduced by settling first then discharge into into the river. Pollution load estimation formulas as well as sample calculation are provided.

165. Cornell Aeronautical Lab., Inc. 1972. Assessment of the environmental effects accompanying upland disposal of polluted harbor dredgings, Fairport Harbor, Ohio. (Appendix A-Supporting data and calculations). Cornell Aeronautical Lab., Inc. Buffalo, New York. Tech. Rept. Cal No. NC-5191-M-1. 42 p.

Upland disposal of polluted harbor dredgings from Fairport Harbor, Ohio, is discussed. It is found that the pollutant loadings can be greatly reduced by settlyng first the discharge into the river instead of direct lake dumping. Pollution load estimation equations as well as sample calculations are provided. Ultimate use of filled disposal areas is reviewed.

166. Coughlan, F. P. 1958. Water intake in the Detroit River. Proc. A.S.C.E. 84(SA6):1855-6, 1855-9.

A submerged crib off Fort Wayne and a tower intake off Grassy Island were considered as the best intake sites for the location of the Wayne County intake. The difference in raw water quality is negligible, and filtered water would be entirely safe and of excellent quality from either site. The tower intake off Grass Island was chosen for the Wayne County intake because (a) a tower intake is accessible for maintenance and repair, while a submerged crib is inaccessible and is more subject to damage from navigation, and (b) a project taking water from a Fort Wayne intake would cost at least $6,000,000 more than the Grassy Island intake. (BECPL)

167. Crane, F. W. 1957. Fiscal operations of the Buffalo Sewer Authority. J. Sanitary Eng. Div. Proc. A.S.C.E. Proc. Paper 1462. Vol. 83(SA 6). 12 p.

This paper is an attempt to describe the fiscal phases of operation of a metropolitan sewage system under a public authority organization. Public authorities have become quite prevalent and much has been said in both their favor and their disfavor. One criticism is their remoteness from political response. One virtue is this same remoteness from political involvement. It is probable that they are not an ideal interpretation of our democratic principles of government, but they are a means for progressive and businesslike accomplishment. (UB)

168. Crane, F. W., G. F. Fynn and C. R. Velzy. 1956. Buffalo sludge disposal facilities. Sewerage and Industrial Wastes. 28(6):765-771.

This plant provides primary sewerage treatment. Facilities consist of 570 mgd main pumping station, coarse trash racks, fine bas screens, grit chambers, and chlorination sedimentation and sludge are disposed by incineration. Sewerage loading is equal to waste from approximately 610,000 persons plus normal industrial and commercial wastes. Design and control of sludge digestion tanks are discussed. (UB)

169. Crim, R. L. 1972. A system of mathematical models for water quality management. Environmental Protection Agency. Field office region III. Annapolis, Md. Tech. Report 51. 27 p.

Properly formulated mathematical models can serve as valuable tools for the evaluation of man's action on the hydraulic and water quality environment. At a time when many stream and estuarine systems are in critical condition, management needs methods which can show the effects of projects beforehand. The models presented here should aid in avoiding costly and time consuming mistakes in the evaluation of alternatives. Virtually any hydraulic distribution problem in the water pollution control field can be solved with these hydraulic models. The results of the models have exhibited a high degree of accuracy.

The quality models are primarily designed to compute the effects of changing flow and point loadings on the system. Much must be done to enable these models to compute the effects of biological actions. Such parameters as photosynthesis and respiration are not adequately defined as yet. Perhaps the availability of these models will stimulate useful formulations of more important biological reactions.

170. Csanady, G. T. 1964. Turbulence and diffusion in the Great Lakes. Internat. Assoc. for Great Lakes Res. Proc. 11th Conf. on Great Lakes Res. pp. 326-339.

In continuing experimental investigations of turbulent diffusion in the Great Lakes, further data have been collected, particularly on vertical diffusion and diffusion in a current which steadily changes direction ("swinging" current). Also a comparison could be made between diffusion in Lake Huron and Lake Erie, western basin. The low values of vertical diffusivity reported before were confirmed, and the extreme influence of thermal stratification on vertical diffusion was

demonstrated. Diffusivities measured in the western basin of Lake Erie were approximately twice as high as those prevailing in Lake Huron, presumably because of higher turbulent intensity in a shallow basin. Diffusion in a swinging current was found to be considerably more rapid than in a steady one, the effective diffusivity (so far as such a concept is useful in that situation) increasing by a factor of 2-5.

171. Csanady, G. T. 1966. Dispersal of foreign matter by the currents and eddies of the Great Lakes. Univ. Mich. Great Lakes Res. Div. Proc. 9th Conf. on Great Lakes Res. Great Lakes Res. Div. Pub. 15:283-294.

The concentration of some effluent at a given point in a lake at a given time after release is a random variable, the full specification of which can only be effected in terms of probability distributions. In practice one would be interested in the maximum concentration which occurs with a given probability. Experimental data available so far do not allow of such estimates as they only refer to mean concentrations. Previous work carried out by the Waterloo research group has shown that, as far as may be judged from the field of mean concentration, horizontal diffusion is mainly a product of the (complex) currents, while vertical diffusion depends on the supply of eddies. Some new work carried out last summer concerned the study of Richardson's distance-neighbor function, which is related to the mean-square concentration fluctuations as well as to the mean. Further work in this direction is hoped to lead to a more detailed description of the turbulent diffusion process in the Great Lakes. Some calculations are presented to show potential pollution hazards from various industrial plants.

172. Csanady, G. T. 1967. Large scale motion in the Great Lakes. J. Geophys. Res. 72(16):4151-4162.

Large-scale motion in the Great Lakes can be assumed to be of small Rossby number, so that the equations of motion can be linearized and at the same time the variation of the Coriolis parameter with latitude can be neglected. When applied to a two-layer lake model, the equations become identical with the equations governing the behavior of surface and internal seiches in lakes, but now 'current-like,' as well as 'wave-like' solutions to these equations become of interest. The four equations of motion in the

horizontal (assuming hydrostatic pressure distribution in the vertical) and the two continuity equations can be reduced to two independent sets of equations for the principal 'internal' and 'surface' modes. The solutions of each of these comprise one stationary mode, possibly some very slow periodic modes akin to Kelvin waves (but only if the basin is large enough) and some faster periodic modes corresponding to surface and internal seiches which rotate around the basin. When applied to a circular basin, constant depth 'model Great Lake' (of dimensions and other characteristics appropriate to the Great Lakes) the theory suggests the existence of (1) baroclinic 'coastal jets' during the summer stratification; (2) slow counterclockwise rotating internal waves of a period many times the half-pendulum day; and (3) surface and internal seiches rotating in either direction and having a period of at most several hours (surface modes) or up to within a small fraction of the inertial period (internal modes). An examination of the available observational material indeed suggests that these features are detectable in the Great Lakes.

173. Csanady, G. T. 1968. Motions in a model Great Lake due to a suddenly imposed wind. J. Geophys. Res. 73(20):6435-6447.

A solution is presented for the initial value problem that arises when a uniform wind stress is suddenly imposed on the surface of a circular, constant depth, two-layer lake that has similar characteristics to the Great Lakes under summer conditions. Even with this minimum number of dynamically significant features in the theoretical model (closed basin, two-layer structure, and constant Coriolis parameter) a number of experimentally found features in the behavior of the Great Lakes are reproduced in a realistic way, the most important such phenomena being (1) large thermocline movements near the shores, (2) coastal jets, (3) rotary currents in the center portion, (4) standing internal waves of long wavelength and large amplitude, (5) standing surface seiches, and (6) rotating surface and internal seiches.

174. Csanady, G. T. 1968. Simple analytical models of wind driven circulation in the Great Lakes. Internat. Assoc. Great Lakes Res. Proc. 11th Conf. on Great Lakes Res. pp. 371-384.

Recent analytical and numerical studies of "Model Great Lakes" are surveyed and their implications for experimental work are discussed. The important dynamical factors in

determining large-scale water movements in the Great Lakes appear to be: (1) wind stress; (2) the constraint of continuity imposed by the shores in a closed basin; (3) Coriolis force, which may be assumed constant for a basin of Great Lakes dimensions. The theoretical studies reveal that, in addition to these three essential factors, the summer density stratification and the variations in depth also exert a controlling influence on the current patterns. The influence of bottom and shore friction appears to be minor, but this is not conclusively established.

Conspicuous and large-scale features of the circulation predicted by theory are (1) coastal jets; (2) thermocline movements in the shore zones and (3) rotation of current patterns.

175. Csanady, G. T. 1968. Wind-driven summer circulation in the Great Lakes. J. Geophys. Res. 73(8): 2579-2589.

Simplified models of wind-forced motions are considered in the two-layer circular basin 'model Great Lake'. Under summer conditions, when a thermocline is present, both a uniform, steady wind and a uniform wind varying periodically in time produce a frictionless lake response characterized by strong boundary currents and pronounced thermocline movements in the shore zone. The length scale determining the width of this shore zone is the 'radius of deformation', typically three miles. Observations on Lakes Huron, Michigan, and Ontario show such motions to be present near the shores.

176. Csanady, G. T. 1970. Dispersal of effluents in the Great Lakes. Water Res. 4:79-114.

A comprehensive description is given of the physical factors involved in the dispersal of "conservative" pollutants in the Great Lakes, based mainly on experimental data obtained in Lakes Huron and Erie over 7 years. Quantitative modelling of small and large scale effluent plumes is illustrated. The results show that, for the practically most important cases, dilution of effluents discharged near the shores by the currents and eddies of the Great Lakes is so feeble as to be almost negligible. Consequently, to achieve practically significant dilution, one has to rely mainly on the efficient design of diffuser ports.

177. Csanady, G. T. 1970. Waste heat disposal in the Great Lakes. Internat. Assoc. Great Lakes Res. Proc. 13th Conf. Great Lakes Res. pp. 388-396.

The energy equation is applied to a flowing sheet of water, subject to surface cooling. This reduces to a two-dimensional diffusion equation if the excess temperature is multiplied by an exponential-decay factor.

An approximate solution is constructed for the diffusion by arranging Gaussian plumes to begin at elements of a line-source, modelling a power station cooling-water outlet. A comparison of the decay of maximum excess temperature with distance from the source due respectively to surface cooling and mixing shows the latter mechanism to be dominant. Some practical conclusions are then pointed out which follow from the result that heat dissipation is "diffusion controlled".

178. Csanady, G. T. 1971. On the equilibrium of the thermocline in a shore zone. J. Physical Oceanog. 1(4):263-270.

The typical spring thermal regime of Lake Ontario shows a thermocline surface of either a "wedge" or of a "lens" shape persisting in the shore zone for a considerable period. The summer regime is characterized by frequent up-tilts or downtilts on the thermocline, with an amplitude comparable in the shore zone to the equilibrium depth of top or bottom layers. These observed facts are explained in terms of a simple theory based on the postulates of geostrophic flow and conservation of potential vorticity. Thermocline shapes and velocity distributions calculated for a constant-depth shore-zone model exhibit many of the observed characteristics of the spring and summer regimes. It is, therefore, suggested that inertial adjustment to geostrophic equilibrium is a primary mechanism in the formation of near-shore tilted thermoclines.

Curtis, L. W. - See: G. D. Simpson, No. 511.

Curtis, L. W. - See: G. D. Simpson, No. 512.

179. Cutler, N. L. 1929. The biological investigations of pollution in the Erie-Niagara watershed. Conservation Dept. New York. pp. 134-139.

The biological investigations of the conditions of pollution in the Erie-Niagara watershed were divided into: (1) Lake Erie and Niagara river, and (2) streams. In a biological study of a lake bottom it is harder to define the three characteristic pollution zones that are usually found in stream studies, i.e.: (a) zone of recent pollution, (b) septic zone, (c) zone of recovery. In an open body of water such as Lake Erie a septic zone is never developed due to the rapid dispersion of the polluting substances through areas confined, as by a breakwater, may approach this condition.

Czapski, U. - See: R. U. Steward, No. 530.

180. Dalton, Dalton, Little. Resource Engineering Associates. 1971. Industrial waste survey for Department of Public Utilities, Clean Water Task Force, Cleveland, Ohio. Program for the lower Cuyahoga River. Dept. Public Utilities. Cleveland, Ohio. 178 p.

In this program was developed a complete analysis of the present water quality in the lower Cuyahoga River as detailed in the document entitled Technical Report. A prediction of future water quality in the lower Cuyahoga River based on certain assumptions regarding interception of all industrial and municipal wastes, the upgrading of effluent of Southerly Wastewater Pollution Control Center, and the achievement of the water quality standards of Aquatic Life A for the upper Cuyahoga River as imposed by the State of Ohio. (CE)

181. Dalton, Dalton, Little. Resourse Engineering Associates. 1971. Industrial Waste Survey for Department of Public utilities, Clean Water Task Force, Cleveland, Ohio. Technical Report. Dept. Public Utilities. Cleveland, Ohio. 175 p.

This Technical Report developed: a complete inventory of all the principal contributors of industrial waste to the Cleveland sewer system; generalized recommendations for treatment requirements for the protection of the Cuyahoga River and Lake Erie; generalized recommendations for pre-treatment requirements for the protection of the sewer system and the wastewater pollution control facilities as well as for the protection of sewer system and plant personnel. (CE)

182. Davis, C. C. 1955. Plankton and industrial pollution in Cleveland Harbor. Sewerage and Industrial Wastes. 27(7):835-849.

Between September, 1950, and September, 1951, a study was made of the Cleveland harbor area in connection with a survey of pollution conditions in Lake Erie. Reports based on results of phytoplankton and zooplankton analysis are discussed. The plankton organisms are used as indicators of polluted waters. (UB)

183. Davis, C. C. 1966. Biological research in the Central Basin of Lake Erie. Univ. Mich. Great Lakes Res. Div. Proc. 9th Conf. on Great Lakes Res. Great Lakes Div. Pub. 15:18-26.

Most of the limited scientific work that has been accomplished in the Central Basin of Lake Erie has been closely associated with practical matters, and hence has dealt mainly with hydrology, fisheries, the search for commercially useful sand deposits, shore erosion, or pollution. Aside from commercial fish-catch data, the only long-term records that have been published are for the phytoplankton of the Cleveland area. There has been a consistent increase of phytoplankton over the years, suggesting a rapid eutrophication of the water. A 1964 study shows an extensive area in the Central Basin where the oxygen content of the bottom waters was very low, or even lacking. A study that had been made in 1929 had failed to uncover any indication of low oxygen except in the immediate vicinity of large cities. An unpublished 1964 investigation of the benthos indicates predominance of pollution-tolerant forms over most of the Central Basin. Extensive previous studies, however, do not exist with which the 1964 results could be compared.

184. Davis, C. C. 1968. Lake Erie's shore and water. In: Proc. of a symposium commemorating the dedication of Cunningham Hall, Kent State Univ. November 1, 1968. pp. 121-134.

Lake Erie has become world-famous for its pollution problems. This paper points out the physical evidences on the pollution problems, such as increased opacity of the water due to greater quantities of planktonic organisms and an increase of total dissolved solids. Charts and tables are given for references.

185. Davis, D. E. 1926. A study of currents in Lake Erie. J. Am. Water Works Assoc. 16(2):155.

Paper describes a phase of study at Erie, Pa., which has to do with the effect of wind and lake currents on the probable distribution of polluted water. (UB)

186. Deane, R. E. 1963. Limnological and meteorological observation towers in the Great Lakes. Limn. and Oceanog. 8(1):9-15.

Six limnological and meteorological single-shaft towers of 4-in. pipe were installed in 3 of the Great Lakes by the Great Lakes Institute, University of Toronto. The towers were of two types, a shallow-water tower for depths of less than 60 ft. where the base of the tower rested directly on the lake bottom, and a deep-water tower supported by a buoyancy tank 25 ft. below lake level. A platform on the towers, situated 8 to 12 ft. above lake level, gave a stable base to house limnological and meteorological instruments and recorders. The platform and upper part of the tower were designed for easy removal and reinstallation.

187. De Blois, K. L. 1926. The St. Lawrence Waterway to the sea. Proc. A.S.C.E. Discussions. 52:86-87.

De Blois discusses fundamental factors that should be before embarking on the improvement of any inland waterway. (UB)

188. DeCooke, B. G. 1961. Forecasting Great Lakes levels. Univ. Mich. Great Lakes Res. Div. Great Lakes Res. Div. Pub. 7:79-84. (RL)

A method of forecasting end of month levels for 6 months in the future is presented. Since all factors affecting the runoff are not easily measurable, indices were employed to represent these variables. The arithmetic average of selected stations was used as the index for precipitation. The end of month flows from selected tributary streams were used as the index of the amount of snow melt during the current month was selected as a current monthly temperature. Precipitation and temperature over the basin were selected as the indexes of the loss of water due to soil moisture recharge. Monthly mean air temperature was an index for evapotranspiration losses. Multiple linear regression equations for computing monthly runoff into Lake Ontario were

developed using the above indices. The development of the forecast method on Lake Superior, Michigan, Huron, and Erie consisted of establishing a point-weight system based on the monthly coefficient of multiple correlation and estimating above and below normal point ranges for the system. These point ranges were then used to select a monthly supply from a table which was based on a net basin supplies of record. (RL)

189. DeCooke, B. G. 1968. Great Lakes regulation. Internat. Assoc. Great Lakes Res. Proc. 11th Conf. Great Lakes Res. pp. 627-639.

The paper presents a brief description of the physical characteristics and of the hydraulics and hydrology of the Great Lakes System, along with a summary of regulation studies conducted during the past half century. The technique employed to develop current operational regulation plans on the lakes and the latest international studies for regulation of the entire Great Lakes, and problems of special interest encountered therein are described. Discussion of the derivation of basic data (e.g. levels, flows, supplies, etc.), uniform base of comparison employed in these studies, requirements of regulation, various approaches to regulation, and methods of evaluating results are included.

190. DeCooke, B. G. 1968. Regulation of Great Lakes levels and flows. Corps of Engineers. Lake Survey Div. Detroit, Mich. Misc. Rept. MP 68-8. pp. 249-275.

The paper presents a brief description of the physical characteristics as well as the hydraulics and hydrology of the Great Lakes system. Included are tables of average lake levels, outflows, runoff, precipitation and evaporation. The rule-and-limitation approach to regulation plan development (a plan tailored to the past sequence of water supplies) and the probabilistic or stochastic approach (a plan which gives consideration to the variability of future water supplies) are described and compared. The paper includes a description and samples of the regulation plans presently in operation on Lakes Superior and Ontario. The paper includes a description and samples of the regulation plans presently in operation on Lakes Superior and Ontario. The author concludes that it is extremely difficult to improve on the natural regulation of the system. However, from an engineering standpoint regulation of the entire system is feasible, but has not been economically justified to date.

191. DeCooke, B. G. and E. Megerian. 1967. Forecasting the levels of the Great Lakes. J. Water Resources Res. 3(2):397-403.

A description is given of the U.S. Lake Survey method of forecasting Great Lakes water levels. The method, in general, consists of determining a level for each month of a 6-month forecast period on each of the Great Lakes by routing a predicted volume of water (Net Basin Supply) to each of the Great Lakes basins. The technique employed in prediction of the volume of the water consists of using multiple linear regressions based upon U.S. Weather Bureau precipitation and temperature data as predictors for the first month and trend predictors for the second through the sixth month. This technique results in forecasting of lake levels on the average from 15 to 40% closer to the recorded lake levels in comparison with the technique that utilizes the long-term average volume of water as the basis of projection.

192. Delos, J. S. 1950. Bacterial survey of stream and bathing beaches at Cleveland. Sewage and Industrial Wastes. 22(12):1618-1624.

This paper gives report on bacterial survey undertaken to determine level of pollution of bathing beaches. Effect of storm water overflows on pollution level and quality of river water discharges into lake are also discussed. (BECPL)

193. Denison, P. J. and F. C. Elder. 1970. The flow of solid-water mixture in hydraulic dredging. Marine Division, U.S. Army Corps Engineers. North Atlantic Div. New York, New York. pp. 83-94.

This paper is concerned with the flow behavior of solids-water mixtures in relation to the physical factors encountered in hydraulic dredging. The rheological properties of solids-water mixtures as related to flow measurements by available process instrumentation and to the capability and performance of the dredging machinery are important factors to consider in controlling the dredging operations. (CE)

194. Denison, P. J. and F. C. Elder. 1970. Thermal inputs to the Great Lakes 1968-2000. Internat. Assoc. Great Lakes Res. Proc. 13th Conf. on Great Lakes Res. pp. 811-828.

A survey of expected man-made thermal inputs to the Great Lakes System from electric generating stations, steel mills, and municipal waste treatment plants for the period, 1968 through 2000, has been completed. The present thermal input of 9.98 x 10^{10} Btu per hour to the total Lake System is expected to rise more than elevenfold to 114 x 10^{10} Btu per hour by the year 2000. As an indication of the magnitude of this projected thermal input, the contribution to Lake Ontario in 2000 A.D. will amount to 6% of the total annual natural heat storage in the Lake.

Dennis, R. W. - See: G. E. Arnold, No. 69.

195. Dent, E. J. 1926. The St. Lawrence Waterway to the Sea. Proc. A.S.C.E. Discussions. 52:86.

Discussion concerning the water level of the Upper Lakes effected by the deeping of channels that were between 8 and 12 ft. to 21 ft. in depth. (UB)

196. Derecki, J. A. 1964. Variation of Lake Erie evaporation and its causes. Univ. Mich. Great Lakes Res. Div. Proc. 7th Conf. Great Lakes Res. Div. Pub. 11:217-227.

Monthly evaporation from Lake Erie was determined by water budget method for the 1937-1959 period. The component factors of water budget are briefly examined and discussed. Evaporation rates varied from -4 to 24 cm per month and from 53 to 108 cm per year; therefore, the average values are poorly adaptable for hydrological forecasts. The variation of evaporation was analyzed statistically and indexes of air-water temperature difference (T_W-T_A), heat influx by radiation (sunshine), and humidity were found to be of primary importance, while precipitation and wind speed showed only sporadic effect. The climatic factors gave reasonable account for the variation of the monthly evaporation rates during the months having high evaporation and poor account during the low evaporation period.

Detwiler, J. D. - See: O. Holden, No. 308.

Devendorf, E. - See: H. H. Black, No. 104.

197. Dickey, G. D. 1956. Plant design for future expansion pays off at Detroit. Water and Sewage Works. 103(8):376-377.

The plant was opened in 1940, and was designed to handle a population of 2,400,000 by 1950. Ideas incorporated to permit ready expansion to accommodate 4 million population are reviewed. Two new pumps, now being installed, will add 300 mgd more capacity. Originally, the sewerage load was 400 mgd containing 200 tons of solid matter, now it is 500 mgd and containing 300 tons of solids. (UB)

198. Dillon, E. P. 1940. Locating and maintaining buoys on the Great Lakes. Civil Engineer. 10(2):103-104.

Methods used to locate and maintain buoys are reported. Overhauling of lighted and unlighted buoys and moorings in the Great Lakes are described. (UB)

199. Dingell, John D. 1966. Great Lakes pollution. In: The Great Lakes--How Many Masters Can They Serve. Michigan Nat. Resources Council 11th Ann. Conf. pp. 19-26.

This paper is a general discussion of pollution of the Great Lakes. Mention is made of over-enrichment of the Lakes and bacterial pollution of the Lakes and tributaries.

200. Dingman, S. L. and A. Assur. 1969. The effects of thermal pollution on river ice conditions. II. A simplified method of calculation. U.S. Army, Cold Regions Res. and Eng. Lab. Hanover, New Hampshire. Res. Rept. 206-II. 10 p.

In a previous report, Dingman et al. (1967) developed a method for calculating the temperature profile of a cooling river below a source of thermal pollution and the length of ice-free reach which could be maintained by such a source. Computer programs were used to calculate heat-loss rates based on mean daily values of meteorological parameters and to numerically integrate a complicated heat-loss expression. The present paper describes a simplified approach to the same problem, in which heat loss is calculated as a linear function of the difference between water temperature and air temperature, so that the integration can be performed analytically. A simplified but fairly general procedure for calculating water-air heat-loss rates on the basis of air temperature, windspeed, solar radiation, and general atmospherica conditions is also presented.

201. Dingman, S. L., W. F. Weeks and Y. C. Yen. 1967. The effects of thermal pollution on river ice condition. I. A general method of calculation. U.S. Army, Cold Regions Res. and Eng. Lab. Hanover, New Hampshire. Res. Rept. 206. 33 p.

The general problem of the magnitude and extent of downstream changes in river temperature due to the addition of "thermal pollution" in various forms is assuming greater importance as man increasingly used river water as a coolant and as a medium for transporting biological wastes. This paper treats a special case: the effects of such heat additions on river ice conditions. The basic approach, however, is applicable to the general problem.

If temperature increases due to thermal pollution are of sufficient magnitude, an appreciable reduction in thickness, or even complete disappearance, of the winter ice cover will result. The thermonuclear production of electrical power with the associated production of large quantities of waste heat is now becoming competitive with the more conventional methods of power production. If it can be established that this waste heat is sufficient to keep major portions of navigable rivers free from ice, the proper positioning of the thermonuclear reactors might permit the effective use of the river by shipping throughout a significant portion of the winter. The advantages of being able to calculate the effects of changes in the amount of thermal pollution, the hydrometric parameters of the stream, and the weather conditions on the position of the ice front below a pollution site are, therefore, obvious.

D'Itri, F. M. - See: C. S. Annett, No. 9.

202. Dohler, G. C. and R. J. D. Mackenzie. 1969. A discussion on the interpretation of high and low water datum planes in the Great Lakes. Internat. Assoc. for Great Lakes Res. Proc. 12th Conf. on Great Lakes Res. pp. 415-440.

There is a growing and continuing requirement for more precise definitions of the various levels of the Great Lakes. Every sector of the Great Lakes Basin community is affected sooner or later by lake levels. The purpose of High and Low Water Datum planes are examined and defined, and the criteria which could meet these requirements are established. All available water level data are analyzed and techniques developed for the selection of appropriate datum planes.

203. Donnan, B. C. 1961. Offshore exploration in Great Lakes region. Am. Assoc. Petrol. Geol. 45(11):1847-1858.

Approximately 35 billion cubic feet of natural gas has so far been produced from beneath the waters of shallow Lake Erie, where offshore activity has been concentrated. Two hundred ninety-three wells have been drilled offshore in Lake Erie and Lake St. Clair to date, with two of these in the United States opposite Pennsylvania.

Offshore development in Lake Erie has been concentrated in the eastern and western sectors. Clinton-Medina gas fields almost surround the east end on land, and underlake extensions of these are being sought. The geological problem has been to trace permeability trends following discovery; a better understanding of the conditions of deposition of these strandline sands is necessary. Modern fracturing techniques have been used successfully in this region.

In the western sector, Guelph gas-bearing reefs and Salina A-2 gas fields have been successfully extended underlake. However, the success ratio in wildcatting for these biostromic structures has been disappointingly low in spite of the use of the various geophysical tools. The geological problem has been in finding a suitable means of location.

The oil discovery in the Trenton Group at Colchester in Essex County, Ontario, near the west end of Lake Erie has resulted in a renewed interest in deeper exploration. It has also resulted in the first commercial oil well in the Great Lakes in 1959. Subsurface geology must be used to locate areas of suitably porous dolomitized Trenton Limestone.

Some offshore wells have penetrated the Cambrian sands and these beds also have oil and gas possibilities, and are of current interest.

An attempt has been made to correlate the various survey maps, where available, in order to show composite geological maps of the western and eastern Lake Erie regions. This geological information has been projected across Lake Erie and Lake St. Clair, where possible, on the basis of information obtained from offshore wells drilled to date. This has been done with due thought to the implications involved in such projections with limited information, and with the different nomenclatures which are encountered when political boundaries are crossed. (BL)

204. Dostal, K. A. and G. G. Robeck. 1966. Studies of modifications in treatment of Lake Erie water. J. Am. Water Works Assoc. 58(11):1489-1504.

Water treatment techniques are reviewed. The information reported herein is a summary of a one-year study conducted in the West Plant, Erie, Pa. During each of the four seasons, a series of filtration runs were conducted with small dual-media filters at various filtration rates. The objectives were to check the influence of the elimination of flocculators and sedimentation basins of effluent quality and length of run.

Duane, D. B. - See: D. W. Berg, No. 94.

205. Duane, D. B. and J. H. Saylor. 1966. Portable Great Lakes research towers. Univ. Mich. Great Lakes Res. Div. Proc 9th Conf. Great Lakes Res. Div. Pub. 15:295-300.

In pursuit of its mission, the scientific investigation and study of freshwater oceanography, the Research Division of U.S. Lake Survey, Army Corps of Engineers, has designed and successfully used oceanographic research towers that are portable yet inexpensive, and successfully used oceanographic research programs. Towers up to 15 meters in height have been assembled from component parts costing less than $800, and have been transported to the offshore site and erected using a "raft" constructed from lumber and 200-liter drums. During the past two seasons, such towers have been assembled and erected at research sites on Lakes Superior, Michigan, Huron, and Erie. These several sites have required erecting the towers in water depths ranging from 4 to 10 meters, and on lake bottoms of varying character. The towers have withstood sustained winds in excess of 22 meters per second as well as waves in excess of 3 meters in height.

206. DuHamel, N. Y. 1941. Great Lakes ports and waterways. Military Engr. 33(188):123-32.

Discussion of commerce of the Great Lakes ports in the U.S.; their structures and equipment; breakwaters in Great Lakes ports; connecting waterways; regulation of lake levels; St. Lawrence waterway; Lake Survey. (BECPL)

Durkin, F. H. - See: E. L. Pucel, No. 467.

207. Dutton, C. S. 1968. Capabilities and limitations in engineering technology. In: Proc. Great Lakes Water Resources Conf. Toronto, Canada. June 24-26, 1968. pp. 433-446.

Sanitary engineers should always provide positive leadership in the entire area of environmental control and, accordingly, are concerned with problems in many major fields including that of water supply, water pollution, air pollution, solids disposal, food technology and occupational health. To bring this short paper to within reasonable bounds it is necessary to narrow this wide field of sanitary engineering interests and, therefore, we will concern ourselves solely with water and waste treatment--a field which is of specific concern to this Conference.

208. Eagle, G. H. 1963. Ohio pollution control policy and Lake Erie. Industrial Water & Wastes. 8(5):19-21.

Pollution control policies in Ohio, as they relate to Lake Erie, presented; list of entirely new and older industrial wastes treatment plants in Lake Erie area given. (UB)

Edinger, J. E. - See: G. E. Arnold, No. 69.

Elder, F. C. - See: P. J. Denison, No. 194.

209. Elkin, H. F. 1955. Sun Oil's new water reuse system. Oil and Gas J. 54(32):88-89.

Comprehensive pollution control of all plants waste waters is reported. Maximum reclamation of spent waters for refinery reuse and virtually unlimited water supply for emergency fire protection accomplished with new water reuse system are discussed. The new system is installed at Toledo refinery in Ohio. The initial operation of this system is very successful. (UB)

210. Elkin, H. F., E. F. Mohler, Jr., and L. R. Kumnick. 1956. Biological oxidation of oil refinery wastes in cooling tower systems. Sewage and Industrial Wastes. 28(12):1475-1483.

New method of utilizing waste waters does not require extensive pretreatment and achieves pollution reduction of overall effluent flow diagram of "re-use" water system at Sun Oil Co., Toledo, Ohio. Phenol removal efficiency and chemical oxygen demand removal efficiency in forced draft cooling tower are described. Chemical quality of cooling tower re-use water is examined. (UB)

211. Elliott, G. H. 1971. A mathematical study of the thermal bar. Internat. Assoc. Great Lakes Res. Proc. 14th Conf. Great Lakes Res. pp. 545-554.

The migrating thermal bar phenomenon has been studied in laboratory and mathematical models. The previously reported temperature fields observed in the laboratory agreed with those observed in Lake Ontario and a linear physical model for the speed of the thermal bar was shown to give reasonable values for both the laboratory model and Lake Ontario. Observations have also been presented of the associated velocity field. On the basis of this laboratory model, which suggested that horizontal advection and diffusion of heat were not of primary importance, mathematical models were developed. First, the temperature field was calculated from the one-dimensional heat diffusion equation. Then the velocity field was calculated assuming that the flow was driven by buoyancy forces and balanced by viscous forces. Since there is a great similarity between the calculated and observed temperature and velocity fields, the assumptions on which the vorticity balance is based are obviously nearly satisfied in the laboratory model. Because of the similitude between the experimental and calculated temperature fields and those observed in lakes, the observed and calculated velocity field may model the flows associated with the thermal bar in the lakes.

From the laboratory and mathematical studies it is also possible to describe the behavior associated with the stationary thermal bar.

212. Elliott, G. H. and J. A. Elliott. 1969. Small scale model of the "thermal bar". Internat. Assoc. Great Lakes Res. Proc. 12th Conf. Great Lakes Res. pp. 553-557.

A 2-dimensional freshwater model was used to simulate the 'thermal bar' phenomenon by heating and cooling the water

through $4^{o}C$. The temperature profiles were similar to observations made in the Great Lakes. The current patterns observed suggest that the "thermal bar" is actually a thermal plume with an overriding wedge of stable water.

213. Elliott, G. H. and J. A. Elliott. 1970. Laboratory studies on the thermal bar. Internat. Assoc. Great Lakes Res. Proc. 13th Conf. on Great Lakes Res. pp. 413-418.

The "thermal bar" has been studied in a quantitative manner in a laboratory model. The temperature and velocity fields are similar to those observed in the Great Lakes. The effects of variation of heat input, bottom slope, and initial temperature were studied. A linear physical model gives a reasonable first approximation to the speed of the "thermal bar" in both the experimental model and the Great Lakes.

Elliott, J. A. - See: G. H. Elliott, No. 212.

Elliott, J. A. - See: G. H. Elliott, No. 213.

214. Elliott, R. V. and D. G. Harkness. 1972. A phenomenological model for the prediction of thermal plume in large lakes. Internat. Assoc. Great Lakes Res. Proc. 15th Conf. Great Lakes Res. pp. 544-564.

A mathematical model for the prediction of the size, shape and orientation of the thermal plumes produced by the surface discharge of heated condenser cooling water has been developed. The model is based on the statistical analysis of a series of measurements made on plumes produced by an operating generating station. Arguments are presented to show that the model can be used for prediction purposes at sites other than where the measurements were made.

215. Environment Control Technology Corporation. 1973. Huron River: Geddes Dam through Ford Lake. Env. Control Technology Corp. Ann Arbor, Michigan. 51 p.

An intensive study of the Huron River from Geddes Dam through Ford Lake was conducted during September, [illegible]. Simulations using separate mathematical models for [illegible] River and Ford Lake indicate that the dissolved [illegible]

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standard would be met in the entire study portion of the river at the seven day, once in ten year drought flow using wastewater loadings determined during the survey. The allowable loadings from the Ann Arbor Wastewater Treatment Plant were determined at the drought flow and are presented. This can be used for evaluating future treatment requirements.

216. Environmental Protection Agency. 1971. 1968 inventory municipal waste facilities--A cooperative state report. Vol. 2. New Jersey, New York, Puerto, Virgin Islands. Environmental Protection Agency. Office of Media Programs, Water Progress. Washington, D. C. EPA Pub. No. OWP-1. 128 p.

The municipal waste facilities described in this publication are those reported by the States and territories of the United States as being in place on January 1, 1968. The data presented were collected by the various State and Territorial Water Pollution Control Agencies, and processed through the Federal Water Pollution Control Administration. A facilities is defined as a treatment plant or where waste water is discharged raw, the collection system for disposal of domestic and industrial waste waters. Facilities are listed alphabetically within States by Community or where a sanitary district public utility district, etc. is concerned, by the name of that entity. (UB)

217. Environmental Protection Agency. 1971. 1968 Inventory municipal waste facilities--A cooperative state report. Vol. 3. Delaware, Maryland, Pennsylvania, Virginia, West Virginia, Washington, D. C. Environmental Protection Agency. Office of Media Programs, Water Progress. Washington, D. C. EPA Pub. no. OWP-1. 161 p.

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218. Environmental Protection Agency. 1971. 1968 Inventory Municipal waste facilities--A cooperative state report. Vol. 5. Illinois, Indiana, Michigan, Minnesota, Ohio and Wisconsin. Environmental Protection Agency. Office of Media Programs, Water Progress. Washington, D. C. EPA publications No. OWP-1. 249 p.

The municipal waste facilities described in this publication are those reported by the States and territories of the United States as being in place on January 1, 1968. The data presented were collected by the various State and Territorial Water Pollution Control Agencies, and processed through the Federal Water Pollution Control Administration. Facilities are defined as a treatment plant or place where waste water is discharged raw, the collection system for disposal of domestic and industrial waste waters. Facilities are listed alphabetically within States by Community or where a sanitary district, public utility district, etc. is concerned, by the name of that entity.

219. Environmental Protection Agency. 1973. Bibliography of R and M research reports. U.S. Environmental Protection Agency. Office of Research and Monitoring. Washington, D. C. Socioeconomic Environmental Studies Series EPA-R5-73-012. 82 p.

This bibliography identifies all current research reports recently published by the office of Research and Monitoring, Environmental Protection Agency. Part 1 of this bibliography identifies reports which relate to all areas of pollution control research in the series. Part 2 contains one of the major separate research series which was discontinued during 1972. This section is a revision of the discontinued publication, "Bibliography of water quality research report" which was last issued in June, 1972. (UB)

220. Environmental Protection Agency. 1973. EPA reports Bibliography. A listing of EPA reports available from the National Information Service as of April 1, 1973. EPA Washington, D. C. Library Systems Branch, Management and Organization Division. Office of Administration EPA-Lib-73-01. 957 p.

This bibliography contains citations, abstracts and authors, corporate sources, subjects, contract and title indexes for all U.S. Environmental Protection Agency and its predecessor agencies's reports contained in the NTIS collection as of April 1, 1973. (UB)

221. Erie and Niagara Counties Regional Planning Board. 1973. Environmental Assessment Statement for the regional water quality management study. Erie and Niagara Counties Regional Planning Board. Grand Island, New York. 275 p. + 7 Appendices.

The Erie and Niagara Counties Regional Planning Board (ENCRPB) has conducted a study on water quality management in Erie and Niagara Counties and subsequently to formulate and present a plan for the orderly development of a water quality management program that will upgrade and/or maintain water quality in Erie and Niagara Counties in accordance with the current New York State Stream Classification Standards. A major emphasis of the study and plan was to be directed toward the collection, treatment and discharge of sanitary sewage. A regional sanitary sewage plan and program (recommended plan) are formulated. The most significant effects of the recommended plan will be on surface water in Erie and Niagara counties, and on international waters in Lake Ontario, the Niagara River and Lake Erie. Other effects will be on ground waters, ecological relationships and other attributes of the natural and socioeconomic environments. Environmental impact and adverse environmental effects of the recommended plan are also discussed.

222. Erie and Niagara Counties Regional Planning Board. 1973. Regional storm drainage management plan. Erie and Niagara Counties Regional Planning Board. Grand Island, New York. 435 p.

The purpose of this Regional Storm Drainage Management Plan is to provide recommended solutions to drainage problems common to Erie and Niagara Counties, New York. Regional guidelines for implementation of the recommended plan are presented to assist governmental agencies and their administrators. Fifteen sub-Regional areas, undergoing rapid urbanization, are investigated in detail; specific recommendations, both structural and non-structural, are made to alleviate and prevent flooding and drainage problems. Legal and administrative actions required to obtain financing for plan implementation are defined. An "Implementation Kit", including a "Flood Plain Regulation Ordinance" and recommendations for erosion control measures, is provided to assist governmental agencies interpret and implement the recommended plan on a local level. A "Storm Drainage Design Manual" was prepared and is published separately.

223. Erie and Niagara Counties Regional Planning Board. 1973. Water quality management study, interim report. Erie and Niagara Counties Regional Planning Board. Grand Island, New York. 337 p.

This study presents a plan for the development of a water quality management program which will restore and maintain the water quality in accordance with the standards set forth by the Stream Classifications. The study has identified present waste discharge from municipal, industrial and agricultural land use. Consideration was given to existing industrial outfalls that are not part of a municipal sewage treatment system or other treatment systems. Methods of solid waste disposal in the study area are discussed.

224. Erie County Management Council. 1973. The state of the environment. Official Report. pp. 14-26; 38-41.

This report renders another comprehensive summary of water treatment in Erie County by the community. It includes water analysis; appraisal of existing treatment facilities by townships; summary chart of the Erie County municipal waste water treatment program; listing of existing and projected programs for the improvement of existing facilities. According to a master's degree project report by Joseph D. Latona in 1968, Erie County facilities received a flow of 215 million gallons per day and had a BOD removal efficiency of 39% and solid sludge efficiency of 40%. Recommendations are made for a county-wide water resources revampment.

225. Ervin, L. 1972. Precise Laser navigation system (plans). Proc. 1st Federal Conf. on the Great Lakes. Interagency Committee on Marine Sci. and Eng. pp. 202-204.

One of the first identifiable problems of which we were made aware by operators on the Great Lakes was the lack of a navigational system for use in the channels confined because of ice, when floating aids to navigation are removed prior to the winter freeze to prevent damage to light buoys. This report reviews the plans to achieve following objectives: 1) demonstrate practicability of season extension, 2) provide a shipboard navigation system for winter operations, 3) give shipmasters visual display of precise position (bow and stern) and speed in channel by using the hybrid radar/laser beam device.

226. Estep, J. M. 1912. Cleveland intercepting sewer system. Eng. News. 67(13):586-589.

Intercepting sewers are being built at Cleveland, Ohio, to direct the sewage from the rivers and their tributaries from the lake front and to convey the sewage to a point of discharge some eight miles distant from the city water works intake. The history of the project is outlined. And the leading features of the work are described. Part of the main intercepter was constructed in open cut and part of it in a tunnel. Some of the sewer is of reinforced concrete lined with brick and part of it of brick alone. The lake outlet is of riveted steel. (BL)

227. Estrade, A. A. 1960. Regional planning in Cuyahoga County, Ohio. J. of Sanitary Eng. Div. Proc. A.S.C.E. Proc. paper 2471. 86(SA3):23-33.

The paper points out the problem created in the field of water supply and sewage by the post war population boom. The manner in which the problem was studied and the observations that were made are examined. (UB)

Etzel, J. E. - See: A. J. Condren, No. 160.

228. Euthenics, Inc. and Polytech, Inc. 1972. Preliminary engineering study--Cuyahoga Valley Interceptor Sanitary Sewer. Euthenics, Inc. and Polytech, Inc. 12025 Shaker Boulevard, Cleveland, Ohio. 65 p + 54 plates + 11 figures.

This report summarizes the engineering studies including analysis of previous reports, population studies, establishment of design criteria, location studies, preliminary design of grades and pipe sizes, proposed construction stages and methods and estimated costs. The report has been prepared in sufficient detail to indicate clearly the problems involved and the alternate solutions available and includes schmatic layouts and sketches to illustrate the recommendations. (CE)

Ewing, B. B. - See: D. D. Meredith, No. 407.

Fadow, M. P. - See: G. S. Annett, No. 9.

Fan, C. Y. - See: R. Nebolsine, No. 422.

Fan, C. Y. - See: R. Nebolsine, No. 423.

Farlow, J. S. - See: A. Okubo, No. 439.

229. Farlow, J. S. 1965. A field technique used for horizontal diffusion studies in Lakes Michigan and Erie. Univ. Mich. Great Lakes Res. Div. Proc. 8th Conf. Great Lakes Res. Div. Pub. 13:299-303.

Locations of 130 plywood floats, each of 120 square inches of area and supporting 4- by 8-foot nylon drogues at depths of either 5 or 20 feet, were determined by aerial photography at 5-minute intervals for 2 hours and then at 10-minute intervals for at least one more hour. This technique was used twice at each of three shallow-water locations in 1964: a mile northwest of Indiana Harbor, Indiana; 5 miles west of Colchester, Ontario; and 3 miles west of Cleveland, Ohio.

230. Fast, M. 1962. International and interstate problems in the management of waters on the Great Lakes. In: Developing effective water management systems to meet increasing demand- The Ohio State Univ. Nat. Resources Seminars. pp. 74-96.

Management of water levels, water quality and any problem of international cooperation are discussed. The fluctuations in water levels lies in the effect of extreme high or low levels on various water uses. Growing concern over deteriorating water quality in the rivers or Lakes resulted in a series of joint conferences by the United States and Canada to the International Joint Commission for an investigation of pollution in these waters. Management plans and remedial measures are made.

231. Fisher and Associates, Inc. 1971. Solid waste management plan of Geauga County, Ohio. Fisher and Associates, Inc. Shaker Heights, Ohio. 151 p.

It is the intention of this plan to provide a guide to the Management of Solid Waste for Geauga County through the year 1990. Cooperation will be required among public officials in realizing their obligation to regulate the system in the most practical and fair manner, including the regulation of practices of refuse collectors, disposal contractors and private citizens in respect to the overall plan. By evaluating background studies involving population projections, land use, transportation, natural resources and natural features, and reviewing all present storage, collection and disposal practices, requirements in all these areas have been determined through the year 1990. (CE)

232. Fleming, R. R. 1968. Frank answers to some hot incinerator questions. Am. City. 83(5):97-98.

The problems of incinerators are discussed in the question and answer format. The incinerators in the North Hempstead, New York and Buffalo, New York are discussed briefly. (UB)

233. Flower, G. E. 1956. Southerly stays modern. Am. City. 71(4):118-120.

Southerly sewage treatment plant in Cleveland, Ohio, can stabilize and purify a flow of 68 mgd. From a flow of 170 mgd, easily settled solids can be removed by primary treatment. The description of new grit chamber and comminutor building is given. (UB)

234. Flower, G. E. 1957. Solving metropolitan Cleveland's sewerage needs. Sewage and Industrial Wastes. 29(1):6-17.

Sewerage plant improvement program in Cleveland, Ohio, is discussed. Interceptors have been designed to receive not only dry weather sewerage flows but also first flush from street washings and continued contributions of storm water. (UB)

235. Flower, G. E., C. B. Budd and C. Hauck. 1938. Effect of activated carbon in digestion of fresh solids--Activated sludge mixtures. Sewage Works J. 10(3):441-449.

Experimental study at Southerly Sewage Treatment Plant, Cleveland, Ohio, is reported. Effect of activated carbon on odor control, digestion process, ph control, solids destruction, settleability of digested sludge as well as filtrability are discussed. Possibility of economizing on dosages of ferric chloride and lime for sludge conditioning before filtration is recommended. (UB)

236. Flower, G. E., C. B. Budd and C. Hauck. 1938. Sludge drying on glass covered beds. Sewage Works J. 10(4):714-721.

Data for Southerly Sewage Disposal Plant of Cleveland, Ohio, are tabulated. Description and operation of the plant are reported briefly. Sludge drying processes are examined and discussed. (UB)

237. Forney, F. H. and G. A. Lynde. 1951. Beach protection engineers attempt to outwit nature at Presque Isle Peninsula. Civil Engr. (NY). 21(9):28-31.

The report gives discussion on forces which cause beach erosion, effects of these forces and design of various types of remedial structures. Proposed protection at Presque Isle is to design and preserve the neck of the peninsula to protect navigation improvements in Erie Harbor. Stabilization of existing shoreline to insure uninterrupted use of access road along the peninsula is recommended. (UB)

238. Foundry. February, 1969. Settling basins clean GM Foundry water. Foundry. Paper no. 16986. 97(2):146.

Discussion of composite settling basin and water recirculat- system that, barring some most unusual accorrence, will preclude pollution of Maumee River by Defiance plants of Central Foundry Division; most significant of the elements of the system is the new basin that can hold nearly 60 million gal. of water; all return waters from various dust collection systems are retained for 19 hrs. in primary basin and for an additional 47 hrs. in secondary basin, for a total retention time of nearly 10 days.

239. Franklin Institute Research Laboratories. 1970. Selected urban storm water runoff abstracts. U.S. Federal Water Pollution Admin. Washington, D. C. Water Pollution Control Res. Series. 11024 EJC 07/70. 375 p.

This is a compilation of abstracts summarizing articles from a variety of technical publications covering the subjects of urban runoff, storm water drainage, storm sewers and legislation--together constituting "the problem of urban drainage". Articles on most general subjects such as "Sewage" or "Sanitary Engineering" and topics not closely related to storm water have been excluded. The present work includes 599 abstracts of documents published from July, 1968, through June, 1970. (UB)

240. Franklin Institute Research Laboratories. 1970. Selected urban storm water runoff abstracts, First quarterly issue. U.S. Federal Water Pollution Control Admin. Washington, D. C. Water Pollution Control Res. Series. 11024 EJC 10/70. 37 p.

The first quarterly supplement to "Selected urban storm water runoff abstracts" is a compilation of abstracts summarizing articles from a variety of technical literature concerning the problem of urban drainage published from July 1970 through September 1970. The 36 abstracts covering eight sections are arranged both alphabetically and numerically by abstract number. Each item includes a bibliographic citation, an abstract and a set of indexing descriptors and identifiers. Also included is a cumulative subject index, an author index and a journal list. (UB)

241. Franklin Institute Research Laboratories. 1971. Selected urban storm water runoff abstracts - Second quarterly issue. U.S. Federal Water Pollution Control Admin. Washington, D.C. Water Pollution Control Res. Series. 11024 EJC 01/71. 45 p.

The second quarterly supplement to "Selected urban storm water runoff abstracts" is a compilation of abstracts summarizing articles from a variety of technical literature concerning the problem of urban drainage published from October 1970 through December 1970. The 50 abstracts covering eight sections are arranged both alphabetically and numerically by abstract number. Each item includes a bibliographic citation, an abstract and a set of indexing descriptors and identifiers. Also included is a cumulative subject index, an author index and a journal list. (UB)

242. Franklin Institute Research Laboratories. 1971. Selected urban storm water runoff abstracts - Third quarterly issue. U.S. Federal Water Pollution Control Admin. Washington, D.C. Water Pollution Control Res. Series. 11024 FJE 04/71. 75 p.

The third quarterly supplement to "Selected urban storm water runoff abstracts" is a compilation of abstracts summarizing articles from a variety of technical literature concerning the problem of urban drainage published from January 1971 through March 1971. The 89 abstracts covering ten sections are arranged both alphabetically and numerically by abstract number. Each item includes a bibliographic citation, an abstract and a set of indexing descriptors and identifiers. Also included is a cumulative subject index, an author index and a journal list. (UB)

243. Franklin Institute Research Laboratories. 1971. Selected urban storm water runoff abstracts - July 1970 - June 1971. U. S. Federal Water Pollution Control Admin. Washington, D.C. Water Pollution Control Res. Series. 11024 FJE 07/71. 173 p.

The July, 1970-June, 1971, supplement to "Selected urban storm water runoff abstracts" is a compilation of abstracts summarizing articles from a variety of technical literature concerning the problem of urban drainage published from July, 1970, through June, 1971. The 234 abstracts covering a range of ten sections are arranged alphabetically by author and numerically by abstract number with each category. Each item includes a bibliographic citation, an abstract and a set of indexing descriptors and identifiers. A cumulative subject index at the end of the volume provides the necessary access to individual concepts. An author index and a journal list are also included. (UB)

Freeman, N. - See: J. P. Coakley, No. 153.

244. Freitag, D. R. 1972. Application of ice engineering and research to Great Lakes problems. Proc. 1st Federal Conf. on the Great Lakes. Interagency Committee on Marine Sci. and Eng. pp. 131-138.

The Cold Regions Research and Engineering Laboratory (CRREL) conducts research, studies, and investigations on physical phenomena associated with temperatures near or below the freezing point of water. Although in the past much of the research has been sponsored by the military, the breadth of the research program has been and remains quite large. There are studies of snow control and removal, ice engineering, fog dispersal, frost effects in soil, interpretation of satellite imagery and forecasting dates of freeze up, ice thickness, etc. A number of basic science studies support this work, for example, research on basic crystallography of ice, paleoclimatology, geophysics, and the ecology of the tundra biome.

Much of the expertise acquired by CRREL has direct application to current problems of the Great Lakes Region. This has recently been recognized by the Corps of Engineers, and the laboratory is active in the study of the extension of the navigation season on the Great Lakes. The specific studies being pursued on that project are: Measurement of forces on ice booms, Measurement of ice forces on waterfront structures, and Measurement of horizontal and vertical ice forces on piling.

Other research directly involving the Great Lakes includes a study of pollution patterns from satellite-based imagery and assistance in the development of bubble systems for ice control.

Frigo, A. A. - See: J. G. Asbury, No. 70.

245. Frigo, A. A. 1972. Prediction of surface plume areas associated with heated discharges into large lakes--A phenomenological model. Internat. Assoc. Great Lakes Res. Proc. 15th Conf. Great Lakes Res. pp. 583-587.

A phenomenological curve for thermal plume surface areas within isotherms has been developed by Asbury and Frigo (1971). From May to October, 1971, temperature surveys of the thermal plumes from several power plants located on Lake Michigan were made by Argonne National Laboratory. The power plants surveyed included the Point Beach Nuclear Power Plant (eleven surveys), the Waukegan Generating Station (two surveys) and the State Line Generating Station (one survey). Areas within surface isotherms were measured and the data plotted on the aforementioned curve. The data points fall within the envelope of data previously plotted by Asbury and Frigo (1971). Thus, this new data further strengthens the validity of this curve.

246. Frigo, A. A., D. E. Frye and P. Siebold. 1973. Temperature and velocity measurements in the near-field region of thermal plumes. Internat. Assoc. Great Lakes Research. Proc. 16th Conf. Great Lakes Res. pp. 684-701.

Field measurements of the near-field temperature and velocity distributions were made near the outfalls of the Point Beach and the Palisades Nuclear Power Plants on Lake Michigan late in 1971 and during the 1972 field year. A two- or three-point mooring system was used to hold a small boat steady, while obtaining simultaneous temperature and velocity measurements. Station locations of the boat were determined using surveyors' transits or a radar range-positioning system. A direct reading current meter with an affixed thermistor was used to measure current velocity and water temperature. Measurements were made as a function of depth at each station location.

In addition, a technique has been developed for studying the time-temperature history experienced by a drogue drifting in a thermal discharge. This drogue may be condisered analogous to an organism drifting in the discharge. Measurements were made at the Point Beach Nuclear Power Plant using a cruciform-style drogue with an attached instrument package consisting of a strip-chart recorder, thermistor and battery pack. The trajectory of the drogue was determined using surveyors'

transits. This experiment demonstrated that a simple inexpensive method can be utilized to measure the time temperature history of an organism drifting in a thermal plume.

247. Frost, S. L. 1965. Lake Erie pollution survey. Ohio Cons. Bull. March. pp. 14-15.

The Public Health Service has launched a comprehensive survey of the quality of water in the Great Lakes and a special study is under way through this agency on Lake Erie. Three basic objectives are as follows:

1. To determine the causes of water pollution and its effects on the quality and beneficiary uses of water.

2. To develop agreements on the desired beneficial water uses and the water quality objectives necessary to accomodate these uses.

3. To determine water quality management measures necessary to achieve the desired objectives, including the establishment of a time table for their accomplishment.

Pollution in Lake Erie is quickly reviewed.

248. Frost, S. L. and R. C. Smith. 1959. Water inventory of the Cuyahoga and Chagrin River Basins, Ohio. Ohio Water Plan Inventory. Vol. 1. Basin Review. 90 p. + 31 plates.

The Cuyahoga-Chagrin report is the first in a series of studies planned to cover each of 18 major river basins and 108 watershed areas in them--a complete coverage of the State. Basically this is a report of facts, that took two years to assemble and interpret; their origin covers long years of research. This report has attempted to set forth the problems in this area as they have been interpreted, and to ease the task of solving them in the future. (CE)

Frye, D. E. - See: A. A. Frigo, No. 246.

Fynn, G. F. - See: F. W. Crane, No. 168.

249. Galloway, F. M. Jr. 1973. The dependence of pollution circulation on the vertical diffusivity in the Western Basin of Lake Erie. Internat. Assoc. Great Lakes Res. Proc. 16th Conf. Great Lakes Res. pp. 702-709.

Numerical and graphical results have been obtained from the computer for the spread of a conservative pollutant in the western basin of Lake Erie. The Gedney-Lick current model was used to describe the circulation. In each example, the spread of pollution was simulated for up to two days.

A strong dependence on the value of the vertical diffusivity was obtained. Using the typical value of 5 cm^2/sec for the vertical diffusivity, it was found that the variation in pollutant concentration in the vertical direction was slight. A value of 50 cm^2/sec for the vertical diffusivity produced pollution contours that demonstrate virtually no variation in the vertical direction. On the other hand a value of .5 cm^2/sec for the vertical diffusivity yielded results in which the pollution contours varied sharply from top to bottom, reflecting the vertical dependence of the currents.

The solutions were mildly dependent on changes in the distribution of pollutant concentration at the mouth of the river from which they were introduced. Because of the sensitivity of these results to the vertical diffusivity, it is concluded that more experimental and theoretical work needs to be done to accurately relate the vertical diffusivity to local conditions.

250. Gannett, F. 1915. Erie can remove flood menace by spending $798,000 on Mill Creek improvement. Eng. Record. 72(15):440-442.

Farley Gannett, in report to City Engineer, recommends channel rectification, closed and open section of conduit and dry reservoir for stream control as the methods to improve and control the flood in Mill Creek. (BECPL)

251. Gannett, F. 1970. Progress and costs on Erie, Pa. flood control project. Eng. News Record. 84(18):852-854.

Construction of the flood protection works at Erie, Pa. involving the improving of Mill Creek flowing through the city, is undertaken. Progress of the project is reported and discussed. (BL)

252. Gannon, J. E. and A. M. Beeton. 1969. Studies on the effects of dredged materials from selected Great Lakes harbors on Plankton and Benthos. Center for Great Lakes Studies. Univ. Wisconsin-Milwaukee. Milwaukee, Wisconsin. Special Report #8. 82 p.

Little information was available on the biological, chemical, and physical characteristics of the harbor and lake disposal environments. In the Great Lakes dredging and water quality project, field investigations were undertaken to determine: (1) the nature of the environments, (2) the effects of dredging on the harbors, and (3) the effects of disposal on the lake environments. This report presents the methods which were developed and the results of biological tests which were made at the Center for Great Lakes Studies, Univ. Wisconsin-Milwaukee. The harbors studied are: Buffalo, N.Y.; Calumet, Ill.; Cleveland, Ohio; Great Sodus Bay, N.Y.; Green Bay, Wis.; Indiana Harbor, Ind.; Milwaukee, Wis.; Rouge River (Detroit, Mich.); and Toledo, Ohio.

253. Gascoigne, G. B. 1916. Cleveland's sewage treated by revolving screens and noval grit chambers. Eng. Record. 73(13):408-410.

The sewage from that part of Cleveland, west of the Cuyahoga River, will be treated at a plant located on the lake front at the foot of West Fifty-eight St. It is intended to use the dilution available opposite this lake front plant, so that ultimately the works will provide for the removal of the suspended inorganic matter; the partial clarification of the sewage; the discharge of the excess storm flow and disinfection during the bathing season. (BECPL)

254. Gascoigne, G. B. 1920. The design of Cleveland's sewage treatment works. Eng. News-Record. 85(8):344-349.

The design plan for three plants of Cleveland to protect bathing beaches and prevent nuisances in Cuyahoga River is given. It includes gratings, grit chambers, and two story tanks with disinfection for two lake front plants. Program for improving sewage and water facilities is outlined briefly. (UB)

255. Gascoigne, G. B. 1922. Cleveland's Westerly and Easterly sewage works in use. Eng. News-Record. 89(13):528-529.

A brief description of design of Westerly and Easterly sewage plants is given in this report. The design is based on dry weather flows of 32 and 92 mgd respectively. Facilities included are bar screens, grit chambers, Imhoff tanks, and disinfection processes. (BL)

256. Gascoigne, G. B. 1932. Sewage Treatment Project--Cleveland. Sewage Works J. 4(6):1102-1103.

The city of Cleveland is now constructing new sewage plants and enlarging old ones. A very brief description of the new plant operation is reported. (UB)

257. Gascoigne, G. B. 1932. Sewage treatment project--Cleveland. Water Works and Sewage. 79(4):121-123.

The work is being planned in such a manner that by the end of 1935, the sewage from the Easterly District will receive 92% of treatment, that from the Southerly District, 85%, and at present that from the Westerly District, 35%. General basis of design, cost of work and program of construction are briefly reviewed. (BECPL)

258. Gedney, R. and W. Lick. 1970. Numerical calculations of the steady-state, wind-driven currents in Lake Erie. Internat. Assoc. Great Lakes Res. Proc. 13th Conf. Great Lakes Res. pp. 829-838.

Solutions for the steady-state, wind-driven currents in Lake Erie have been obtained by numerical methods. A shallow lake model, which does not require the friction layers to be small by comparison with the depth of the lake, has been used. In order to obtain some of the observed features of the currents, it was necessary to use a relatively small grid (3.22 km). This grid was variable in size for the mesh points adjacent to the boundaries and this permitted the boundaries to be approximated accurately.

The velocity as a function of depth and horizontal position has been determined. Results are presented for southwesterly and northeasterly winds. In both cases, narrow bands of strong currents were found near the shore. In other areas, large subsurface gyres were evident. The calculated results compare quite well with seabed drifter measurements and other observations.

259. Gedney, R. T. and W. Lick. 1971. Numerical calculations of the wind-driven currents in Lake Erie and comparison with measurements. Internat. Assoc. Great Lakes Res. Proc. 14th Conf. Great Lakes Res. pp. 454-466.

The steady-state, wind-driven velocities in Lake Erie have been calculated numerically using a shallow lake model. The three-dimensional velocities as a function of depth and horizontal position are displayed for the prevailing southwest winds. The results show that the velocities vary greatly from position to position and depend strongly on the bottom topography and boundary geometry. For the numerical calculations, a 0.805 km grid size in an island region and a 3.22 km grid size in the rest of the lake had to be incorporated to represent adequately the Lake Erie geometry.

The calculated velocities compare quantitatively very well with current meter measurements made at mid-depths in the central and eastern basins. The magnitudes of the average eddy viscosity used in the calculations agree with measurements made in the Great Lakes. Steady currents are shown to occur usually after two days to fairly uniform winds.

260. Gedney, R. T. and W. Lick. 1972. Wind-driven currents in Lake Erie. J. Geophys. Res. 77:2714-2723.

The steady-state wind-driven currents in Lake Erie are investigated. A numerical solution for the mass-transport stream function and the three-dimensional velocities as a function of depth and horizontal position is obtained and compared with measurements. The agreement is good. This report shows that the currents depend strongly on bottom topography and boundary geometry.

261. Gedney, R. T., F. B. Molls and W. Lick. 1973. A simplified stratified lake model for determining effects of wind variation and eddy diffusivity. Internat. Assoc. Great Lakes Res. Proc. 16th Conf. Great Lakes Res. pp. 710-722.

The steady-state, wind-driven circulation is calculated in a stratified lake composed of two layers having uniform, but unequal densities and eddy diffusivities. The position of the thermocline and the velocities in both layers are calculated from an asymptotic solution of the shallow lake equations when the Ekman number in the epilimnion (upper layer) is of order one, but the ratio of hypolimnion (lower layer) to epilimnion eddy diffusivities is much less than one.

Large differences in the thermocline shape and the velocities occur between the solution for uniform wind stress and the one for unit order wind stress gradients. For the latter solution, the hypolimnion eddy diffusivity magnitude has an important effect.

262. Gelinas, P. J. and R. M. Quigley. 1973. The influence of geology erosion rates along the north shore of Lake Erie. Internat. Assoc. Great Lakes Res. Proc. 16th Conf. Great Lakes Res. pp. 421-430.

Shoreline erosion in the central part of the north shore of Lake Erie, between Rondeau to the west and Long Point to the east, is estimated by comparison of early surveys of the shoreline (~1810) with recent air photographs of the same area (1963). The total wave energy reaching the shoreline has been calculated from five-year weather records and appropriate wave forecasting techniques. A nearly linear correlation exists between total wave energy at the breaking point and the long-term average rate of erosion except for two coastal areas, one east of Port Stanley and the other east of Port Burwell, where the erosion is significantly faster.

Erosion rates vary from 0.25 m/yr near Rondeau to about 2 m/yr east of Port Stanley. The two areas of excessive erosion (~3 m/yr) correlate with non-cohesive sand and silt deposits extending to water level.

The morphology of the bluff varies from "flat" during periods of low water level to "steep" during periods of high water level and active erosion. A preliminary erosion model based on the mechanics of slope instability is presented.

Gerber, H. B. - See: G. E. Arnold, No. 69.

263. Gerdel, W. E. 1942. Sludge digestion--design study, observations and development at Cleveland, Ohio. Water Works and Sewage. 89(10):409-415.

The design studies, observations, and developments at Westerly Sewerage Treatment Plant, Cleveland, Ohio, are reported. The heated separate sludge digestion units at the Westerly Plant serves to reduce the total dry solids in the raw sludge by one third and in so doing reduces the volatile content of the sludge by one half. A stabilized well-digested sludge is produced which has lost all of its original and objectional character. (UB)

264. Gerdel, W. E. 1957. Improvements at Southerly sewerage treatment plant, Cleveland, Ohio. Sewage and Industrial Wastes. 29(8):875-882.

Principal items to be constructed are additional sludge filtering and incinerating facilities, repairs, and conversion of Imhoff tanks to secondary digesters. (UB)

Gessner, J. J. - See: H. V. Myers, No. 418.

Gilbert, P. H. - See: G. M. Sturman, No. 532.

265. Gill, G. C., E. W. Bierly and J. N. Kerawalla. 1963. An inexpensive rocket technique for obtaining low level wind profiles. Univ. Mich. Great Lakes Res. Div. Collected Reprints. 1:274-279.

An inexpensive, reusable, cold propellant (no fire) rocket has been adapted so a continuous smoke stream is emitted from the instant of launching to an altitude of 1,200 ft. The smoke column is photographed simultaneously at 10-sec intervals by two cameras located 2,000 ft. from the launch site and at right angles to each other. Results are presented in terms of north-south and east-west components of the wind speed at any desired altitude to 1,200 ft. A brief cost analysis is presented as evidence that the rocket technique is quite inexpensive relative to other systems in use today.

266. Gillies, D. K. 1959. Winds and water levels on Lake Erie. Univ. Mich. Great Lakes Res. Div. Great Lakes Res. Pub. 4:35-42.

With reasonably accurate forecasts from a weather office and the relationships proposed in the paper, it is possible to produce an operationally useful forecast of lake levels at Buffalo and Toledo. These forecasts have been very useful to Ontario Hydro in the hourly and daily scheduling of hydraulic and steam generating requirements for the past three years. (RL)

Goodsell, Leonard J. - See: Albert G. Ballert, No. 78.

267. Gotaas, H. B. May, 1969. Outwitting the patient assassin: the human use of lake pollution. Bull. Atomic Scientists. pp. 8-10.

Gotaas challenges some aspects of the emphasis on nutrient removal in current antipollution programs. Alternate approaches such as seeding desirable fish and re-establishing commercial fishing on the Great Lakes, may offer more promising and less costly ways to restore biological balance in the Lakes. (CE)

268. Great Lakes Basin Commission. 1968. Comprehensive framework study. Plan of study document. Great Lakes Basin Commission. Ann Arbor, Mich. 316 p.

The regional description includes discussion of the drainage area, geology, topology, hydrology, resources, navigation, flood control, beach and shoreline, flooding and erosion, water supply, recreation, and water quality problems are all discussed in the present tense, along with water sheds and data collection programs. Regional recommendations made by States within the Lake Erie study area include: increased environmental quality, increased water supply, improved water quality, low flow augmentation, flood management and control, navigation development, develop water recreation. The objectives of the study are to identify related water and land resource problems for year 1980, 2000, 2020, as defined by lake, State and planning sub-areas.

269. Great Lakes Basin Commission. 1969. Great Lakes Basin Library interim bibliography. Great Lakes Basin Commission. Ann Arbor, Mich. 257 p.

This bibliography represents an interim publication of the holding of the Great Lakes Basin Library, included at this time are only those reports, documents, and other official publications in the collection.

270. Great Lakes Basin Commission. 1972. The future of the Great Lakes. Great Lakes basin framework study. Great Lakes Basin Commission. Ann Arbor, Mich. 60 p.

This meeting considered the 25,000 square miles of the Lake Erie basin in the United States and its population, uses and development of land and water; the shoreline; recreation and commerce on the Lake; floods and flood damages; and water quality protection. (CE)

271. Great Lakes Basin Commission. 1972. Official Record of a public meeting held in Buffalo, New York. Great Lakes Basin Commission. Ann Arbor, Mich. 57 p.

Report of the development of a framework as a basic plan in the Great Lakes region for the resource, conservation, and development for fifty years into the future. Some of the basic constraints the study operates under is that no new data or new studies will be undertaken to generate the framework study recommendations. The framework study reports the general nature of resource problems which are now occurring and which are projected to occur in the future; analyzes the probable nature of some of the solutions to those problems; estimates when those solutions might be most appropriate to solve the problems; and gives a generalized cost estimate as to what those solutions might be and who will pay for them. (CE)

272. Great Lakes Basin Commission. 1972. Official Record of a public meeting held in Cleveland, Ohio. Great Lakes Basin Commission. Ann Arbor, Mich. 57 p.

Report of the development of a framework as a basic plan in the Great Lakes region for the resource, conservation, and development for fifty years into the future. Some of the basic constraints the study operates under is that no new data or new studies will be undertaken to generate the framework study recommendations. The framework study reports the general nature of resource problems which are now occurring and which are projected to occur in the future; analyzes the probable estimates when those solutions might be most appropriate to solve the problems; and gives a generalized cost estimate as to what those solutions might be and who will pay for them. (CE)

273. Great Lakes Basin Commission. 1972. Official Record of a public meeting held in Erie, Pa. Great Lakes Basin Commission. Ann Arbor, Mich. 81 p.

Report of the development of a framework as a basic plan in the Great Lakes region for the resource, conservation, and development for fifty years into the future. Some of the basic constraints the study operates under is that no new data or new studies will be undertaken to generate the framework study recommendations. The framework study reports the general nature of resource problems which are

now occuring and which are projected to occur in the future; analyzes the probable nature of some of the solutions to those problems; estimates when those solutions might be most appropriate to solve the problems; and gives a generalized cost estimate as to what those solutions might be and who will pay for them. (CE)

274. Great Lakes Basin Commission. 1972. Report to the States. Ann. Rept.--Great Lakes Commission. Great Lakes Basin Commission. Ann Arbor, Mich. 49 p.

Reports on mean lake levels, erosion report according to states shipping volume. Otherwise, little specific data legislation and commission activities.

275. Great Lakes Basin Commission. 1972. Report to the States, 1971-72 Great Lakes Basin Commission. Ann Arbor, Mich. 53 p.

While this report is principally a review of the commission's activities, it does include some data on mean water levels, total lake shore subject to flooding, cargo traffic statistics, Welland Canal and winter navigation figures. The following subjects are discussed as well: erosion, pollution and pollution control, water quality, shipping, and the winter navigation program.

276. The Great Lakes Institute. 1969. Proc. Conf. for the users of the Great Lakes. The Great Lakes Institute. Univ. Toronto. Toronto, Ont. 131 p.

The purpose of the Conference was to provide a forum for users and managers of the Great Lakes so that they could examine critically the detailed relevance to their needs, of current research and development. There were no speakers; that is, no prepared papers were given, only discussion. The following topics were reviewed: water supply and treatment; navigation and electric power; industrial development; commercial fisheries; recreation and tourism; and wildlife and land conservation.

277. Great Lakes Research Center. 1968. Water characteristics of Cleveland Crown filtration plant. Great Lakes Research Center. Detroit, Mich. 3 p. + 7 plates.

Since its installation, the Cleveland Crown filtration plant, most westerly of three that service the Cleveland metropolitan area, has experienced difficulty in treating raw water because quality fluctuates at various times during the year. One of the more serious problems is concerned with periodic treatment of complex organic ferrous manganese compounds in the raw water. Iron in the reduced state undergoes oxidation after passing through the filtration plant causing the finished water to exhibit a yellowish cast. This condition is most encountered during the summer months. The City of Cleveland has implied that one of the major sources of ferrous manganese in the raw water is the Corps of Engineers dredged spoil disposal site at Lorain, Ohio, about 17 miles west of the intake.

278. Great Lakes Research Institute. 1973. Selected analysis and monitoring of Lake Erie water quality, annual report, 1973. Great Lakes Res. Inst. 60 p.

Quantitative data on selected physical, biological, and chemical parameters of the water in the vicinity of Presque Isle. Information from data is used in planning the management of desired water quality in the area of Erie, Pennsylvania.

279. Great Lakes Research Institute. 1973. Supplement, selected analysis and monitoring of Lake Erie water quality, annual report, 1973. Great Lakes Res. Inst. 7 p.

Statistical analysis of the Lake Erie water quality study data. Graphs of response vs. time of sampling to depict the behavior of the responses in the time sequence of their sampling. Summary statistics carried out by means of computer output.

280. Great Lakes Water Quality Board. 1973. Great Lakes water quality annual report. Internat. Joint Commission. Washington, D. C. Great Lakes Water Quality Board. 315 p.

This report presents a current assessment of water quality in the boundary waters of the Great Lakes, and of the control programs and other measures set forth in the Agreement. The report is designed to highlight problems related to water quality and control programs and descriptive material has been limited to the extent possible. Pollution sources covered are: municipal; industrial; land use activities; shipping activities; dredging activities; onshore and offshore facilities.

281. Greater Cleveland Growth Association. 1971. A new approach to the Cleveland/Northeastern Ohio region; The Lake Erie international jetport project. The Greater Cleveland Growth Assoc. Cleveland, Ohio. 212 p.

Recent studies have concluded a new airport facility is needed to accommodate the air transportation growth of Cleveland and Northeastern Ohio and have indicated the desirability of locating the airport in Lake Erie contiguous to the City of Cleveland. This engineering committee was formed to develop the conceptual design for an International Jetport in Lake Erie and to determine if there were any engineering obstacles which would prevent its development. The conceptual design would provide a basis for preliminary definition of facility requirements of the airpors and related ground transportation, of feasible construction methods and basic cost assumptions.

Grench, R. E. - See: J. G. Asbury, No. 71.

282. Gross, M. G. 1971. The pollution of the coastal ocean and the Great Lakes. United States Naval Inst. Proc. V. 97(819):228-243.

Waste disposal is especially troublesome in coastal urban centers where land for traditional waste disposal operations, such as sanitary landfill, is limited or completely unavailable. Yet, such visible blight seems almost trifling compared to the often invisible harm we are doing to our coastal waters and Great Lakes. This paper gives a quick review of what is pollution and sources of pollutants. Pollution on Lake Erie fishery is mentioned. No specific method of improvement is discussed.

Grossman, I. - See: W. A. Bruce, No. 123.

283. Gustafson, P. F. 1970. Future levels of tritium in the Great Lakes from nuclear power production. Internat. Assoc. Great Lakes Res. Proc. 13th Conf. Great Lakes Res. pp. 839-843.

During the 1970's, a number of nuclear power stations will go into operation on the Great Lakes. Due to its release rate, radioactive half life, and biological activity, tritium will assume major importance among the reactor discharges to the lakes. At equilibrium, the reactors now under construction on Lake Michigan will lead to a level

of about 30 to 100 T.U. (tritium units; one T.U. = one atom of tritium per 10^{18} atoms of hydrogen) in the Lake, depending upon the mixing assumptions, which compares with the peak tritium concentration from weapons testing reached in 1963-1964. Fewer reactors on the other lakes will lead to correspondingly lower T.U. levels. Lake Michigan represents the major tritium source in the Great Lakes system, and transport of this tritium through the system will be discussed, as will the biological implications of the predicted tritium levels.

284. Haimes, Y. Y. 1971. Modeling and control of the pollution of water resources systems via multilevel approach. Water Resources Bull. Paper no. 63896. 7(1):93-101.

A general mathematical model, where the pollution effluent is discharged directly into the river, into the lake, or into a bypass pipe leading to an advanced waste water treatment plant, is developed. The Water Resource Systems under consideration is decomposed into subsystems. Treatment cost functions and quality transition functions as well as system model constraints are introduced, where all functions can be nonlinear. A system Lagrangian is formed to incorporate the system constraints and coupling. 16 references.

285. Hamblin, P. F. 1969. Hydraulic and wind-induced circulation in a model of a Great Lake. Internat. Assoc. Great Lakes Res. Proc. 12th Conf. Great Lakes Res. pp. 567-582.

The steady state hydraulically induced circulation of a rotating lake of circular plan is studied by means of numerical solutions of the equations of fluid motion. Frictional dissipation is assumed to be accounted for by constant lateral and vertical eddy diffusivities. In a homogeneous lake of uniform depth, the circulation consists of a diffuse flow from source to sink throughout the lake. For a parabolic basin, the flow is divided into two unequal streams, each following the shoreline and having a width of approximately 10 km. Circulation due to a uniform windstress directed along a diagonal of the basin of variable depth from source to sink obscures the underlying hydraulic circulation.

When two-layer stratification is taken into account, the steady state hydraulically driven circulation undergoes a

marked alteration. Hydraulic flow in the upper layer assumes a configuration similar to that of the homogeneous lake of constant depth. Windstress applied to the upper layer from the source to the sink has the effect of concentrating the hydraulic circulation in a narrow stream along the shoreline of the lake to the right of the direction of flow.

286. Hamblin, P. F. 1971. Circulation and water movement in Lake Erie. Department of Energy, Mines and Resources. Canada Inland Waters Branch. Scientific Series no. 7. 49 p.

This report provides a summary of presently available knowledge of the circulation, water movements and diffusive processes occurring in Lake Erie compiled from published works and results of recent studies conducted at the Canada Centre for Inland Waters. In addition, the residence time, theory of lake circulation and diffusion are discussed. An atlas of monthly averaged currents is provided in an appendix.

Hammer Mill Paper Company. - See: City of Erie, Pennsylvania, No. 147.

287. Hanna, John E. 1970. A situation report: Great Lakes water levels. Limnos. 3(1):23.

Lake Erie is the most susceptible of the Great Lakes to seiches primarily because its long axis is parallel to the prevailing wind direction. The effect of precipitation on Lake Erie's situation in 1969 is discussed.

288. Hanna, J. 1973. The Great Lakes are overflowing again. Limnos. 5(3):12-18.

An expert looks at Lake levels. Tells what's going on, why they're rising and what we can do about it.

Haras, W. - See: J. P. Coakley, No. 153.

289. Hardin, E. A. 1958. Water intakes in the Detroit River. J. of the Sanitary Eng. Div. Proc. A.S.C.E. Proc. paper 1592. 84(SA 2):24.

A new water supply system will serve the suburban communities of the south eastern part of Wayne County, Michigan. Important features of this new system are a water intake in the Detroit River and a 4 mile long 12-foot diameter raw water

tunnel extending inland to a pumping station and purification plant. This system and other intakes of the Detroit River are described in this report. (UB)

290. Hardin, J. R. 1952. Waterway traffic on the Great Lakes. A.S.C.E. Trans. Paper no. 2496. 117:351-360.

Since the earliest items in U.S. history, the Great Lakes have been a vital artery of commerce, serving an area rich in natural resources and industrial facilities. From meager beginnings as storm havens for sailing vessels, great harbors have been developed and are maintained by the Great Lakes Division of the Corps of Engineers, U.S. Army. The work of this division in improving harbor and navigational facilities is recounted. Statistics are cited to show the magnitude of commerce carried by the lakes and the dependence of this shipping on constant maintenance of channels and harbors. The increase of Great Lakes trade to world-wide scope would be made possible by construction of the St. Lawrence River Seaway facility, and the cost and significance of this project are discussed. (UB)

Harkness, D. G. - See: R. V. Elliott, No. 214.

291. Hartley, R. P. 1964. Effects of large structures on Ohio shores of Lake Erie. Ohio Geol. Surv. Rept. Invest. 53. 30 p.

Effect of such structures as breakwaters and jetties extending into Lake Erie which have had measurable effect on half mile or more of shore; most of large structures along Ohio shore have caused build-up of beaches on their updrift sides and accelerated erosion downdrift; effects are not balancing, since length of eroding shore is ordinarily five or more times the length of the shore which is protected by build-up. (UB)

292. Hartley, R. P. 1968. Bottom currents in Lake Erie. Internat. Assoc. Great Lakes Res. Proc. 11th Conf. Great Lakes Res. pp. 398-405.

In the summer of 1965, seabed drifters were released in Lake Erie primarily along the south shore and in the western basin. Returns have indicated clockwise bottom eddies in the Toledo-Detroit area, in the island area, and in mid-lake in the west half of the central basin. They have

also indicated eastward bottom flow in a narrow band along the south shore and in a wider band along the north shore of the central basin. Centers of eddies may be significant repositories for pollutants. The center of the large clockwise gyre in the central basin may accumulate material originating all along the south shore of the central basin. The Toledo-Detroit eddy suggests accumulation of materials therein from these cities.

293. Hartman, W. L. 1970. Resources crises in Lake Erie. Explorer. 12(1):6-11.

Despite the tremendous value of the Great Lakes, a malaise is seriously destroying their worth. Accelerated enrichment, unabated pollution, over-exploitation, and accidental and intentional introductions of exotic species, have been guided--more often misguided--by man. Of all five Great Lakes, Lake Erie stands out as the one most seriously damaged and in the greatest further jeopardy at the present time. The thermal pollution on fishery and aquatic resources are discussed in this report.

Harvey, P. J. - See: R. Nebolsine, No. 422.

294. Hassan, J. and R. Sweeney. 1972. Influence of the Upper Niagara River Ice Boom on the climate of Buffalo, New York. Great Lakes Lab. Special Rept. No. 13. 33 p.

This paper was generated from research to determine the possible impact of the Lake Erie ice boom at the head of the Niagara River on the climate and air pollution of the Great Buffalo area.

Hauck, C. - See: G. E. Flower, No. 235.

Hauck, C. - See: G. E. Flower, No. 236.

295. Havens and Emerson. 1968. Feasibility of a stabilization-retention basin in Lake Erie at Cleveland, Ohio. Havens and Emerson. Consulting Enginr. Cleveland, Ohio. 145 p. + figures.

A feasibility study was conducted of a stabilization-retention basin to be constructed in Lake Erie at Cleveland, Ohio. The stabilization is viewed as a possible alternative to separation of a combined sewer system. The proposed basin would treat flows from a number of large combined

sewer overflows, from several polluted streams, and effluent from a large secondary wastewater treatment plant. Treatment would consist of bio-oxidation, sedimentation, stabilization, and disinfection.

The chemical, biological, physical, and structural aspects of the proposed basin were studied, and the probable benefits to water quality and the effectiveness of the basin as a treatment device were evaluated.

296. Havens and Emerson. 1968. Master plan for pollution abatement, Cleveland, Ohio. Havens and Emerson. Consulting Enginr. Cleveland, Ohio. Vol. 1. Narrative Report. 160 p.

Pollution in the Cleveland area is a metropolitan problem. There are many sources of pollution, and there is no single step which will correct the problem. Therefore, a multi-purpose plan has been prepared which involves some 40 projects, dealing with the sewer system, the treatment plants, the streams, the Cuyahoga River, and with Lake Erie. Each of these projects is needed to meet the overall needs. The proposed program is the first major step, and it will enable Cleveland to meet the basic water quality criteria now established. It is possible that even higher criteria will eventually be established, and that additions and modifications will be required in the future. (CE)

297. Havens and Emerson, Ltd. 1970. A plan for water quality management in the Central Cuyahoga Basin. Havens and Emerson. Consulting Engr. Cleveland, Ohio. 133 p. + 5 appendices.

The report contains results of a study of the tributary area of the Cuyahoga River between Cleveland and Akron, to guide the development of future wastewater collection and treatment. Plans for water quality improvement as well as recommendations are outlined. (CE)

298. Havens, W. L. 1942. Sewage development in Cleveland. Am. City. 57(10):42-44.

Illustrated description of design equipment and operation of Cleveland's three sewage treatment plants--the Easterly, Westerly and Southerly Sewage Treatment Plants. (BL)

299. Hawkins, R. F. 1942. New Lake Erie water supply system of Toledo. Water Works and Sewage. 89(4):165-168.

The paper describes the particulars of a supply system to serve an ultimate population of 750,000. New works include intake crib and conduit low service pumping station, Lake Erie supply line, filter plant, 35 million gal. reservoir, high service pumping plant water tank and trunk main. (UB)

300. Heavey, W. F. 1933. Breakwaters on Great Lakes. Military Engr. 25(144):486-489.

Review of recent practice in breakwater construction with timber crib, rubble mound breakwaters, concrete superstructures, and concrete-caisson breakwaters. Wave action on breakwaters is discussed. The use of steel for breakwaters must also be considered now according to comparative costs, corrosion of steel, advantages and disadvantages. (BECPL)

301. Hendry, J. R. 1922. Detroit's intensive sewer construction problem. Eng. News-Record. 89(18):745-748.

Detroit is in the third year of an intensive sewer construction program. The third phase of the problem was the question of sewage treatment. It is agreed that an average pollution not to exceed 500 *E. coli* per 100 c.c. in the river is a reasonable index of the pollution permissible. All the new work in connection with the sewer system is being done with this treatment feature in mind. Diversion chambers, interceptor crossing and like accessories are being built into the new sewers. (BL)

302. Henry, T. B. 1952. Proposed sewage works improvements at Toledo, Ohio. Sewage and Industrial Waters. 24(11):1339-1348.

Present plant units consist of two mechanically cleaned bar screens, two detritors, eight primary settling tanks and eight digesters. Study reveals need for removal of suspended solids, effective and continuous sterilization and reduction of biochemical oxygen demand. Activated sludge is selected as type of secondary treatment. Aeration tanks designed have the capacity of 12.5 mgd each. (BECPL)

303. Hensen, P. 1940. Lake Erie water for Toledo. Eng. News-Record. 124(1):59-60.

Abstract of the paper on the new Lake Erie water supply for Toledo, Ohio, is reported. The intake station is 2 miles from shore through an intake conduit. The lake shore raw water pumping station has a 78-in. pipe line 2 miles long to the filter plant on the edge of the city. The 80 mgd filter plant consists of a filter water reservoir, a high lift pumping station and a truck main across the city. (BL)

Henson, E. B. - See: M. S. Hundal, No. 316.

Herdendorf, C. E. - See: R. A. Brant, No. 111.

Herdendorf, C. E. - See: G. D. Hobson, No. 306.

Herdendorf, C. E. - See: L. J. Waters, No. 676.

Hill, H. E. - See: P. C. Hyzer, No. 321.

304. Hiney, R. A. 1969. Optimum regulation of the Great Lakes. Internat. Assoc. Great Lakes Res. Proc. 12th Conf. Great Lakes Res. pp. 449-468.

In 1964 the Canadian and American governments authorized a massive international study to determine what measures could be taken to further regulate the levels of the Great Lakes. A regulation subcommittee is currently devising and testing regulation plans in an endeavor to find one plan that will best serve all Great Lakes interests.

This paper investigates the feasibility of using a dynamic programming algorithm to find this optimum regulation plan given objective functions relating dollar losses of each interest to monthly mean lake levels and outflows. The optimum plan will be that which minimizes these objective functions for a given set of inflows and flow constraints. Inflow sequences will consist of both the recorded-adjusted net basin supplies and 390 years of artificial monthly net basin supplies simulated to preserve as nearly as possible the serial and interlake correlations observed during the period of record.

The regulation rules will be derived from a multiple regression analysis. The resulting empirical formulas will

relate the monthly regulated outflow from each lake to significant hydrological parameters such as antecedent inflows and current lake levels. Comparison of losses incurred with the derived plan to those which would occur for the same inflows and existing conditions will indicate the benefits attributable to the plan.

305. Hoak, I. E. 1928. Regulation of the Great Lakes. Eng. News-Record. 100(3):121-122.

This paper reviews the paper of John R. Freeman. Regulation of lake levels with a variation of less than a foot between summer and winter stages is not considered possible. A plan for regulating lake levels is suggested. (BL)

306. Hobson, G. D., C. E. Herdendorf, and C. F. M. Lewis. 1969. High resolution reflection seismic survey in western Lake Erie. Internat. Assoc. Great Lakes Res. Proc. 12th Conf. Great Lakes Res. pp. 210-224.

The Geological Survey of Canada, in cooperation with the Ohio Geological Survey, undertook a continuous marine seismic profiling survey in the western part of Lake Erie during August-September, 1968. Seismic coverage, totalling 818 mi, was obtained approximately every 5 minutes of latitude and logitude west of Point Pelee in both Canadian and United States waters. Record quality varies considerably over the survey area. East of Pelee and Kelleys Islands, data are good and provide a reliable interpretation of thickness of bottom sediments and stratification within them. The westernmost portion of the basin yields poor data; this is probably due to gaseous organic material, sand bodies, or buried peat deposits.

Drift thickness from drill holes and from the survey correlate well and range from zero up to 120 ft. A major reflector within the drift indicates the surface of glacial deposits and the general pattern of late glacial and post-glacial drainage during low-level phases of Lake Erie.

Offshore bedrock elevation varies between 390 and 571 ft. above sea level. Bedrock highs underlie Point Pelee and the islands whereas bedrock lows in inter-island areas and the central basin are readily outlined. An interpretation of preglacial drainage is presented.

307. Hodges, G. F. 1970. A submersible self-contained water quality meter. Internat. Assoc. Great Lakes Res. Proc. 13th Conf. on Great Lakes Res. pp. 1004-1014.

This paper describes the development, design and construction of a submersible water quality monitoring instrument. The unit is powered by rechargeable batteries and automatically scans and digitally records on magnetic tape eight water quality parameters.

The type of sensors used, the recording system and method of operation are discussed.

308. Holden, O., W. H. Breithanpt, S. Shupe, E. T. Sterne, J. D. Detwiler, H. G. Acres, W. G. Ure, S. W. Archiball, W. M. Veitch and A. J. Connor. 1938. Flood control in Southwestern Ontario--Discussion. Eng. J. 21(5):236-245.

The discussion on the Adams's paper, Flood control in Southwestern Ontario, consists of an analysis of the meteorological conditions that preceded the major floods in rivers, a comparative evaluation of the surface run-off in the river basin, a discussion of agriculture drainage and its possible relationship to floods and a brief geophysiographical description of the watershed involved. (UB)

309. Hollmer, A. 1967. The effect of sill-type channel modifications in the Niagara River on Lake Erie water levels. Internat. Assoc. Great Lakes Res. Proc. 10th Conf. Great Lakes Res. pp. 208-213.

The effects of a sill-type structure in the upper Niagara River on Lake Erie water levels are determined. Various heights, lengths and locations of sills are considered. It is found that for some sills, the low levels could be raised significantly with a corresponding minimum increase in high levels. During years of high lake levels, it is shown that it is hydraulically feasible to use the Black Rock Canal to augment the discharge capacity of the Niagara River to the extent that the lake levels can be lowered more than they are raised by the sill.

310. Howe, W. T. 1907. Stone breakwater construction at Huron, Ohio. Eng. News. 58(8):183-184.

Method of constructing stone breakwater at Huron, Ohio, is discussed. The designed jetty at Huron is demonstrated. (BL)

311. Howell, J. A., K. M. Kiser and R. R. Rumer. 1970. Circulation patterns and a predictive model for pollutant distribution in Lake Erie. Internat. Assoc. Great Lakes Res. Proc. 13th Conf. Great Lakes Res. pp. 434-443.

A transition probability matrix method is developed to represent, in a compact and usable form, the flows measured in a rotating model of Lake Erie. The matrix was determined for the case of zero wind stress and restricted to the Western Basin. The resulting representation was in good conformity with the model and also showed some similarities with average bulk flows in the prototype. The model was used to predict the steady state concentration distribution of a non-conservative pollutant in the Western Basin under conditions of zero wind stress.

Howson, L. R. - See: W. W. Aultman, No. 72.

312. Hubbell, G. E. 1937. Grit chamber model tests for Detroit, Michigan sewage treatment project. Proc. A.S.C.E. 63(10):1867-1882.

Reports on model tests of grit chambers, made in connection with design of sewage treatment plants, are given. Observation were made on flow distribution and grease removal, and the percentage of removal of sand of various sieve sizes for any given length of the tank. Field tests on large scale models were also conducted. (BL)

313. Hubbell, G. E. 1939. Grit chamber model tests for Detroit, Michigan sewage treatment project-Discussion. Proc. A.S.C.E. 65(2):275-276.

Further discussion of particle size on sedimentation settling velocities, and particles sizes and tank velocity is outlined. (BL)

314. Hubbell, G. E. 1940. Hydraulic model studies solve backwater gate design. Eng. News-Record. 124(19):73-74.

Results of hydraulic tests of models for economic design of 6-chamber backwater structures are reported. Data obtained from model test with flow of 3,000 cfs., and revisions in design are also provided. (BL)

315. Hubschman, Jerry H. 1971. Lake Erie: pollution abatement, then what? Science. 171(3971): 536-540.

Long-term eutrophication may be utilized to an advantage. There is still a tremendous task ahead both in identifying the cause and effect relationships of eutrophication and in developing new corrective measures. Efforts must be expanded to study the lake as a system of complex interrelationships.

316. Hundal, M. S., F. Martinek, E. B. Henson and R. E. McLay. 1972. A computer model for predicting thermal discharges in large lakes. Internat. Assoc. Great Lakes Res. Proc. 15th Conf. Great Lakes Res. pp. 606-613.

General mathematical models for predicting power plant thermal discharges in large lakes are presented. The models simulate these effects in three regions: (1) an open channel outfall, (2) a mixing zone close to shore, and (3) a floating plume at a large distance from shore. The effects of mass and energy exchange with the environment are included. The models are used to predict the effects of thermal discharges from the Ginna Nuclear Power Plant on Lake Ontario by using published meteorological and lake data and first hand information on power plant size, etc. The temperatures and flow velocities are computed for the extremes of summer and winter; a decrease in temperature to approximately $1^{o}C$ at 1,000 m is shown. The results are seen to compare favorably with actual temperatures reported in a previous work. The effects of hypothetical cooling towers and cooling ponds are computed and compared with the extreme summer case. Meteorological changes close to the plant are predicted for extreme cases.

317. Hunt, I. A. and Bajorunas, L. 1959. The effect of seiches at Conneaut Harbor. J. of the Waterways and Harbors Division. Proc. A.S.C.E. Paper 2067. 85(WW2):31-41.

Conneaut Harbor has a record of unusually frequent accidents. This paper analyzes seiches on Lake Erie and shows that there is a correlation between water level fluctuation recorded at Buffalo and the accidents at Conneaut. (UB)

318. Hutchinson, Jay G. 1973. Lake Erie diary: an intimate appraisal by canoe. Limnos. 5(4):18-21.

Description of Lake Erie and its distressed condition as seen during a canoe trip from Maumee Bay to New York's Lake Erie State Park.

319. Hydroscience Inc. 1973. Limnological systems analysis of the Great Lakes. Phase I. Hydroscience, Inc. Westwood, New Jersey. 473 p.

The purpose of this report is to present an assessment of the feasibility of applying a Limnological System Analysis (LSA) to the water resource problems of the Great Lakes. A methodology that proceeds along two parallel lines in order to evaluate the feasibility of the Limnological Systems Analysis is established. The first line of analysis evaluates the present and future water resource problems and water use interferences with their associated water resource variables. The second line of analysis evaluates presently available data, problem oriented mathematical models, and present state of the art of models and model building which are required for a Limnological Systems Analysis. The two lines of analysis are synthesized into a problem and model ranking of priority from which feasibility recommendations are drawn. In order to illustrate the Limnological Systems Analysis in several problem contexts, a demonstration modeling framework was constructed.

320. Hyland, J. R. 1964. Rubble-mound breakwater design for refuge harbor. J. of the Waterways and Harbors Div. Proc. A.S.C.E. Paper 4139. 90(WW4):87-98.

An investigation for small-boat refuge project at Kelleys Island (at the western end of Lake Erie) was conducted and breakwaters were designed by use of statistical data and analysis from existing data and soundings made in the field. Wave diffraction and reflection theories were used together with rubble-mound stability data from tests conducted previously. Design wave height, breakwaters alignment minimum weight of cover stone, and elevation and width of crown are given. (BECPL)

321. Hyzer, P. C. and H. E. Hill. 1957. Scheduling equipment for Great Lakes channel dredgings. Civil Eng. (NY). 27(7):46-48.

Connecting channels authorized to be deepened are 168 miles in length and the total amount to be moved is 18,500,000 cu. yd. by hydraulic dredge and 28,500,000 cu. yd. by other dredges. For every one foot over-depth there is the change of 15% of estimated total pay quantity. Dredge capacities are also determined. Available major dredging equipment in Great Lakes area is sought. Dredging schedule in units of 1,000 cu yd is set. (UB)

322. Institute of Man and Science. 1971. The Lake Erie Congress, the Proc. of the First Session. Inst. of Man and Sci. Rensselaerville, New York. 42 p. + 5 appendices.

The First Session of the Lake Erie Congress formally approved 18 resolutions as drafted and modified in Committee and House actions. A brief summary and description of the resolutions are provided. (CE)

323. International Great Lakes Levels Board Regulation Subcommittee. 1969. Report to the International Great Lakes Levels Working Committee by the Regulation Subcommittee. Coordinated basic data. 14 p. + 3 appendices + 48 tables.

The Regulation Subcommittee was assigned the task of computing and coordinating the water supply data required for the development of regulation plans and to derive the basis of comparison for these plans. Preliminary water supplies and comparison data, covering the period January, 1900, through December, 1964, were issued in April, 1967. Subsequently, final water supplies and the basis of comparison data, covering the period January, 1900, through December, 1967, have been developed and coordinated. This report provides a description of the methods employed to obtain the final data and contains tabulations of these data, and the tabulations of the basic data used in their derivation. (CE)

324. International Joint Commission. 1961. Safeguarding boundary water quality, a cooperative effort between the United States and Canada under international treaty. Internat. Joint Comm. Washington, D. C. 32 p.

The aim in this brochure is to draw attention to the great developments that are taking place along the boundary waters, the importance of these waters in this growth to the people of both countries and to record some of the accomplishments in the control of water quality. If this vast stretch of water is to serve effectively the many functions expected of it, pollution control must be a prime objective. This task is a big one, but much has been done to put the program into effect. Neither sewage nor industrial wastes must impair the quality of these waters. This publication describes the steps taken by the International Joint Commission in conjunction with the pollution control agencies on both sides of the boundary. The information and data herein contained cover the period to the end of 1959.

325. International Joint Commission. 1968. Interim report on the regulation of Great Lakes level. Internat. Joint Comm. Washington, D. C. 20 p.

This interim report describes features of the lakes which relate to their levels; indicates the interests which make direct use of the lakes and are affected by lake level variations; discusses the problem of regulating the levels by controlling lake outflows; sets forth the nature, scope and progress to date of the Commission's study, and indicates how it is oriented toward a comprehensive consideration, within the terms of reference, of the many facets of the lake-regulation problem.

326. International Joint Commission. 1969. Potential oil pollution incidents from oil and gas well activities in Lake Erie, their prevention and control. Internat. Joint Comm. Internat. Lake Erie Water Pollution Board. Washington, D. C. 163 p.

The potential for incidents of oil pollution in Lake Erie, includes, but can by no means be limited to, oil and gas well exploration and development. Other potential sources which pose possibly greater threats are the significant tonnages of oil in a ship's fuel bunkers, industrial spills, and the continuing discharge of oils in municipal and industrial effluents. Oil and gas well explorations have been conducted in the Canadian Waters of Lake Erie since 1913, without serious pollution incident. It is recognized, however, that if drilling is expensive, accidents may result. To minimize pollution from this source and its effects,

comprehensive oil and gas well drilling regulations providing lake-wide compatibility and including effective pollution control provisions and surveillance, are required. In addition, emergency standby arrangements are required to produce Lake Erie's valuable water resource from the effect of spills of oil, or other hazardous materials. This report attempts to deal with the suitability of existing drilling regulations, the science of containment and clean-up, and the adequacy of current contingency planning.

327. International Joint Commission. 1969. Vol. 1. - Summary. Internat. Joint Comm. The International Lake Erie Water Pollution Board and the International Lake Ontario-St. Lawrence River Water Pollution Board. Washington, D. C. 150 p.

This report has been prepared in three volumes. In volume 1, the Boards have endeavored to summarize the findings and to identify the critical problems of pollution and pollution control measures which are of immediate concern to both countries as well as those long range problems which must be brought under continuing review and study.

328. International Joint Commission. 1969. Vol. 2. - Lake Erie. Internat. Joint Comm. The International Lake Erie Water Pollution Board and the International Lake Ontario-St. Lawrence River Water Pollution Board. Washington, D. C. 316 p.

This is the second report of the series of three on pollution in Lake Erie and Lake Ontario. This volume contains the scientific and engineering data and findings which have been used to determine the sources and levels of pollution in Lake Erie as well as recommendations for necessary remedial measures.

329. International Joint Commission. 1970. Pollution of Lake Erie, Lake Ontario and the International Section of the St. Lawrence River. Internat. Joint Comm. Canada and United States. Paper 18385. 174 p.

The report of the commission incorporates relevant excerpts from the three interim reports on an extensive and intensive inquiry into the pollution of the lakes and the St. Lawrence estuary. The report includes inquiry into the adequacy of existing safety requirements applicable to underwater drilling and production operations in Lake Erie to prevent oil escaping into the Lake. (UB)

330. International Joint Commission. 1973. Great Lakes water quality. Ann. rept. to the Internat. Joint Comm. Great Lakes Water Quality Board. Washington, D. C. 315 p.

A general description of the present water quality of the various bodies of water in the Great Lakes drainage system permits an evaluation of compliance with the objectives set forth in the Great Lakes Water Quality Agreement. The various lakes and connecting channels are described in turn in hydrologic sequence beginning with Lake Superior. The descriptive material for each water body provides a summary of the water quality parameters and the highlights of waste loading and areas of non-compliance. A complete compendium of water quality and data on direct discharge of waste load is provided as a separate appendix to the report and is available upon request. The waste loading data in this report represent direct discharges to the boundary waters. Tributaries are considered as point sources which include minicipal and industrial, as well as land drainage contributions upstream.

331. International Joint Commission. 1973. Operation of the Lake Erie--Niagara River ice boom: 1972-1973 winter season. Internat. Joint Comm. Internat. Niagara Board of Control. Washington, D. C. 12 p.

Ice boom during the winter of 1972-73 was presented. This was the ninth season of operation of the ice boom. The Board considers that the ice boom functioned as intended to the benefit of the power entities and shore property interests, without detriment to navigation and environmental interests.

332. International Joint Commission. 1973. Report on Great Lakes water quality for 1972. Internat. Joint Comm. Washington, D. C. 30 p.

This is the first annual report of the International Joint Commission pursuant to the Great Lakes water quality agreement between the United States and Canada signed on April 15, 1972. The Commission's report takes cognizance of significant developments through mid 1973 but is based for the most part on the data available in the April, 1973, report of the Great Lakes Water Quality Board. General pollution problems have been discussed and remedial measures are outlined.

333. International Joint Commission. 1973. Semi-annual report of the Research Advisory Board to the International Joint Commission. Internat. Joint Comm. Research Advisory Board. Washington, D. C. September, 1973. 5 p. + 9 Appendices.

This report to the International Joint Commission by the Research Advisory Board is the second semi-annual report from this Board. It covers the activities of the Board from April through September, 1973. The activities of the seven standing committees are outlines. Special research needs for Great Lakes water quality are reported. The report identifies problems relative to water quality, where information is absent, inadequate or not easily accessible; thus creating an atmosphere in which it is difficult to make rational, well-informed, scientifically-based management decisions for the Great Lakes. Recommendations for each problem discussed are also provided.

334. International Joint Commission. 1974. Detailed study plan to assess Great Lakes pollution from land use activities. International Reference Group on Pollution of the Great Lakes from Land Use Activities. Internat. Joint Comm. Great Lakes Water Quality Board. Washington, D. C. 81 p. + 5 Appendices.

A study plan composed of four tasks is reported to investigate pollution of the boundary waters of the Great Lakes system from agricultural, forestry and other land use activities. Task A is devoted to the collection and assessment of management and research information and, in its later stages to the critical analysis of implications of potential recommendations. Task B is first the preparation of a land use inventory, largely from existing data, and, second, the analysis of trends in land use patterns and practices. Task C is the detailed survey of selected watersheds to determine the sources of pollutants, their relative significance and the assessment of the degree of transmission of pollutants to boundary waters. Task D is devoted to obtaining supplementary information on the inputs of materials to the boundary waters, their effect on water quality and their significance in these waters in the future and under an alternative management scheme. The proposed Schedule of Activities for the Land Drainage Reference Study, is included in this submission together with descriptions of these activities, participating agencies and costs. A summary of the budgetary requirements is included in Appendix 1-2.

335. International Waterways Commission. 1910. Report of the International Waterways Commission on the regulation of Lake Erie. Internat. Waterways Comm. Buffalo, N. Y. 169 p. and graphs.

An examination of Plate 21 shows that for a year of excessive supply, such as 1876, the regulation of Lake Erie would not improve navigation. In 1895, a year of deficient supply, the mean level during the eight-month season of navigation would have been raised from 571.31 under natural conditions, to 572. 41 under regulated conditions, and navigation would have been improved by an increase of 1.1 feet in the stage. The extreme low stages for the navigation season would have been raised at least 1 foot without appreciable increase in the extreme high stage. This is equivalent to deeping every harbor and channel in Lake Erie by that amount. (BECPL)

Irbe, J. G. - See: T. L. Richards, No. 482.

Izatt, J. B. - See: M. D. Palmer, No. 446.

Izatt, J. B. - See: M. D. Palmer, No. 447.

336. Janowitz, G. S. 1971. The coastal boundary layers of a lake. Internat. Assoc. for Great Lakes Res. Proc. 14th Conf. Great Lakes Res. pp. 578-581.

The linear hydrostatic coastal boundary layers which bring the horizontal motion to rest at the shores of a lake of horizontal extent L and uniform depth H were investigated. The fluid is homogeneous and in a state of turbulent motion characterized by constant horizontal and vertical eddy viscosities A_H and A_V. The motion is induced by a steady non-uniform wind stress applied at the free surface. Our theory is applicable when

$$(H/L)^2 \leq (A_V/fH^2)^{1/2} \quad (A_H/fL^2) \leq (A_V/fH^2)^3 \ll 1$$

where f is the Coriolis parameter. The coastal boundary layer is composed of two overlapping layers of thickness $(A_H/f)^{1/2}$ and $(A_H/f)^{1/2}/(A_V/fH^2)^{1/4}$. If the wind stress is uniform, then there are regions near the shore where mixing of coastal waters and interior waters is prohibited. The theory further predicts conditions under which the upwelling of bottom waters is enhanced.

337. John Carroll University. 1970. The environmental problems of the Lake Erie Basin. John Carroll Business Bull. John Carroll University. Cleveland, Ohio. 36 p.

This report presents general pollution problems associated with the Lake Erie Basin. The special interest is its water quality.

338. Johnston, T. T. 1895. Regulation of Lakes Levels with reference to improving waterways. In: Proc. 1st Ann. Convention. Internat. Deep Waterways Assoc. Cleveland, Ohio. September 24-26, 1895. pp. 135-140.

The lake level control is practicable from all points of view, the greatest difficulty being found in the international and the least difficulty in the engineering questions involved. It is useful not only from consideration of finance and convenience but also because it will preserve existing conditions. (UB)

Jones, D. L. - See: C. F. Powers, No. 465.

339. Jones, D. L. and F. R. Bellaire. 1962. A numerical procedure for computing wind driven currents on the Great Lakes. Univ. Mich. Great Lakes Res. Div. Great Lakes Res. Div. Pub. 9:93-102.

The problem of accounting for the numerous variables that control the currents in surface lake waters is considered. Models of Hunt, Ayers, Defant, and Sverdrup were utilized to develop an expression for the surface water current from a given shore-wind regime. Data were employed to test the model for four 10-day periods, and later for 10 stations for 47 days. The procedure consists of computing the scalar components of the water current vector for several points in Lake Michigan from given shore-based wind velocities and air stability data. Results are compared with the values of currents computed by standard oceanographic techniques.

340. Jones, D. M. A. and D. D. Meredith. 1972. Great Lakes hydrology by months, 1946-1965. Internat. Assoc. Great Lakes Res. Proc. 15th Conf. Great Lakes Res. pp. 477-506.

Monthly estimates of precipitation on each lake, evaporation from each lake surface and runoff into each lake from surrounding land areas are developed for the Great Lakes for calendar years, 1946-1965. Overlake precipitation is estimated by extrapolation of the land isohyetal patterns multiplied by lake-land ratios as established from island-shore stations. Evaporation by months is calculated using the mass transfer method. An isopleth mapping technique is used to estimate the runoff. The net basin supply for a lake is equal to the total runoff plus the precipitation on the lake surface minus the evaporation from the lake surface. The monthly and annual net basin supplies for each lake are determined from the estimated values of runoff, precipitation and evaporation and are compared with the monthly and annual net basin supplies as reported by the U.S. Army Corps of Engineers. The estimated 20-year mean annual net basin supply for all lakes is about 6% less than the value reported by the U.S. Army Corps of Engineers.

341. Jones, J. A., S. Abram, D. Astry, R. Macer and K. Seckinger. 1969. Water quality of Lake Erie and its tributary streams in Western New York. Lake Erie Env. Studies Tech. Data Rept. No. 1. Fredonia State College. Fredonia, New York. 37 p.

The report summarizes a six week study undertaken under the authors' supervision. Six tributary streams, on the Dunkirk-Erie region were sampled to determine the water quality of streams to Lake Erie and to show these streams contribute to the water quality of Lake Erie. 23 chemical parameters were measured. Casual observations during the course of the study indicated inadequate treatment facilities for a number of pollutants at several sources.

342. Jones, W. A. 1897. The control of the levels of the Great Lakes. Eng. Mag. 8:217-222.

The report shows that it is possible, by a system of dams at the outlets of the Great Lakes, to maintain their surfaces at a constant level and thereby facilitate navigation and commerce. (BL)

343. Karl, R. Rohrer Associates, Inc. 1971. Underwater storage of combined sewer overflows. U.S. Federal Water Pollution Control Admin. (EPA) Washington, D. C. 170 p.

The purpose of this study was to demonstrate offshore underwater temporary storage of storm overflow from a combined sewer in flexible tank. Site selection, model testing, system design, construction and one year's operation were conducted under this study. A pilot demonstration facility was constructed in Sandusky, Ohio, where combined sewer overflow from a 14.86 acre residential drainage area was directed to two-100,000 gallons collapsible tanks, anchored under water in Lake Erie. The stored overflows were pumped back to the sewer system after a storm event for subsequent treatment. During the year's operation a total of 988,000 gallons of storm overflow was contained and returned for treatment. (UB)

Katz, P. L. - See: A. G. Kizlauskas, No. 347.

Keller, M. - See: J. F. Carr, No. 141.

Kerawall, J. N. - See: G. C. Gill, No. 265.

King, J. C. - See: N. L. Liver, No. 386.

344. Kirshner, L. D. 1968. Effects of divisions on the Great Lakes. In: Proc. of Great Lakes Water Resources Conf. June 24-26, 1968. Toronto, Canada. pp. 277-310.

Effects of diversions on the levels and outflows of lakes connected by channels affected by backwater, such as Lakes Michigan, Huron, and Erie in the Great Lakes system, are discussed. The diversions considered consist of diversions into and out of the drainage basin of the lakes and of diversions between the lakes. The histories and features of the five existing diversions in the Great Lakes basin that meet these conditions are outlined.

The ultimate effects of the Great Lakes diversions upon their levels and outflows, which have already been reached, are listed. General commentary is made upon the effects of high and low lake levels and outflows on the three major Great Lakes interests--riparian proper ties, navigation, and hydro-electric power--that are concerned with the levels and outflows and upon the manner in which increases

and decreases in Lake levels and outflows resulting from diversions increase or decrease the effects. References are listed for representative reports and studies on the Great Lakes that pertain to or consider the Great Lakes diversions.

Kiser, K. M. - See: J. A. Howell, No. 311.

345. Kisicki, D. R. 1973. Environmental management of the Great Lakes international boundary areas. Dissertation, Cornell Univ. Ithaca, NY. 279 p.

Water quality, water pollution, waste discharge in the international areas are reviewed and discussed. The environmental impact and management on water quality and waste water are discussed.

346. Kite, G. W. 1972. An engineering study of crustal movement around the Great Lakes. Inland Waters Branch. Dept. of Environment. Ottawa, Canada. Tech. Bull. 63. 57 p.

Vertical movement of the earth's crust in the Great Lakes region can be computed from lake level measurements over long periods of time. This report summarizes the methodology used and provides results for all of the Great Lakes. An earlier report describes in detail the background, literature survey, the theory and development of a methodology for data on Lake Superior. The study was conducted by the Central Region, Engineering Division as part of an ongoing investigation into the hydrology and hydraulics of the Great Lakes.

347. Kizlauskas, A. G. and P. L. Katz. 1973. A two-layer finite difference model for flows in thermally stratified Lake Michigan. Internat. Assoc. Great Lakes Res. Proc. 16th Conf. Great Lakes Res. pp. 743-753.

Circulation, free surface and thermocline displacements are modelled for thermally stratified Lake Michigan under two different wind forcings. The time-dependent vertically intergrated equations of motion and continuity for two coupled homogeneous layers (representing the thermal stratification) are solved numerically. A time and space-staggered uniform grid system (applied to realistic Lake Michigan shore and bottom configuration) is used in the

finite-difference scheme of numerical solution.

The forcing terms included in the model formulation are surface wind, bottom, and interface stresses; Coriolis; and prescribed inflows and outfalls.

The steady state solutions for the two cases considered agree with known Lake Michigan velocity, thermocline, and free surface displacement characteristics.

Kczaja, R. D. - See: D. E. Barry, No. 86.

Kovacic, E. J. - See: E. L. Pucel, No. 467.

Kovacik, T. L. - See: L. J. Walters, No. 676.

348. Kovacik, T. L. 1972. Information on the velocity and flow pattern of Detroit River water in Western Lake Erie revealed by an accidential salt spill. Ohio J. Sci. 72(3):81-86.

On 2 December 1970, a dock of the Detroit Bulk Dock Inc., in Detroit, Michigan, gave way, spilling 20,000 tons of rock salt into the Rouge River, a tributary of the Detroit River. The rate and pattern of flow of the salt into the southern end of the western basin of Lake Erie were measured by monitoring the chloride content of Lake Erie water received at the Toledo Water Treatment Plant.

On 10 December 1970, a salt-rich (35 ppm NaCl) water mass, having chloride concentrations twice the normal background, was detected at the Toledo Water Intake. This demonstrated clearly that Detroit River water does indeed move far into the southwestern basin of Lake Erie, a fact for which previous scientific support has been limited, and permitted a determination of the rate at which the water moves across the lake, at least at this time of year. After correcting for the time during which the salt mass was in the Rouge River and Detroit River, and the time required for the water to travel from the Intake to the Toledo treatment plant, the velocity of this salt-rich water mass across western Lake Erie, i.e. from the mouth of the Detroit River to the Toledo Water Intake was calculated to be approximately 0.3 feet/second.

349. Kramer, J. R. 1964. Theoretical model for the chemical composition of fresh water with application to the Great Lakes. Univ. Mich. Great Lakes Res. Div. Proc. 7th Conf. on Great Lakes Res. Great Lakes Res. Div. Pub. 11:147-160.

It has been stated that parts of the Great Lakes (and particularly Lake Erie) have changed chemically very drastically during the past few decades and that the changes are due to increasing introductions of materials due to increased populations and/or the natural "aging" of lakes. To determine what causes the changes in concentration, a detailed examination is required of how concentrations due entirely to natural processes come about; such a determination can be used as a reference in order to judge the effects of artificial (man-made) contributions to the chemistry of the lakes. It is also desirable within the calculations to estimate any upper limit concentration controls that natural processes may bring to bear. That is, we wish to ask are there any ultimate limits (and what are they) to the inorganic composition of fresh water. The model for fresh water then should allow 1) the calculation of upper limits on fresh water composition due entirely to natural processes, 2) the calculation of the degree of pollution from comparison of the actual composition with the natural process calculations, and 3) the calculation of absolute concentration limits due to natural processes and pollution.

350. Kramer, J. R. and G. K. Rodgers. 1968. Natural processes and water quality control. In: Proc. of Great Lakes Water Resources Conf. June 24-26, 1968. Toronto, Canada. pp. 419-432.

The purpose of this paper is to develop principles and operational techniques regarding two points: 1) a long range water use plan for the Great Lakes requires quantitative knowledge of cycles of constituents and natural processes, and 2) natural processes may be used to define modern engineering programs to obtain and sustain high quality water at minimum cost.

In summary, 1) water quality must be linked to natural processes in order to evaluate the effect of change with time, 2) the Great Lakes because of their size will not reflect change for up to a decade after the change is initiated, and 3) each Great Lake is unique relative to depth, volume, bottom sediment, and to a certain degree must be considered individually. It is, therefore, important to develop a water quality model valid for long time periods (or independent of time) which will take into consideration the individual characteristics of each of the Great Lakes.

351. Krauss, F. E. and Plude, G. H. 1972. 1,200-ft. graving dock. In: J. The Waterways, Harbors and Coastal Eng. Div. Proc. A.S.C.E. Proc. paper 9389. 98(WW4):549-560.

This paper presents a technical description of the design and construction of the largest drydock on the Great Lakes. It is located at Erie, Pa. and was intended to facilitate a novel method of constructing iron ore carriers of 50,000 long ton capacity and to render docking service to them.

The term graving dock is defined as that particular type of drydock which is excavated from the ground. The graving dock was to be the terminus in the fabrication-assembly line of midbody modular sub-assemblies and to provide a place where the midbody could be joined to the bow and stern sections which were to be constructed elsewhere. Each would be assembled in a vertical position on a hydraulic positioner which would then rotate 90° to bring the module into location for joining to the previous unit. Upon completion of the junction the dock would partially flood the midbody for movement clear of the positioner for the next module assembly, and then immediately pump dry. This cycle of operations was to be repeated 20 odd times until a midbody of over 800 ft. had been constructed and was to continue through all seasons without planned interruptions.

352. Ku, L. F. 1970. Spectra of monthly mean water level in the Great Lakes. Internat. Assoc. Great Lakes Res. Proc. 13th Conf. on Great Lakes Res. pp. 844-861.

The annual variation, Sa, and its harmonics appear significantly in the spectra of monthly mean water level in the Great Lakes. The energy of the spectra is concentrated in low frequencies and the plots of background in the spectra at all stations are similar. The coherent energy between Lake Superior and each of the other Lakes is relatively lower than that of other pairs. The phase of Sa increases from east to west. In Lake Superior it lags about 2 months behind that of Lake Ontario. The amplitude of Sa computed by least squares decreases as the number of points increases. For Lakes Superior, Huron, and Erie the amplitudes approach 6 cm when 48 years of data are used. The amplitude in Lake Superior is the same as that in

Lake Erie, and its value in Lake Ontario is 12 cm larger than that in Lake Huron. Owing to the relatively small contribution towards the variance by the annual term and its harmonics, it is not practical to predict the monthly mean water level using only the periodic components.

353. Kugelman, I. J. and J. M. Cohen. 1971. Chemical-Physical processes. Advanced Waste Treatment and Water Reuse Symposium. Great Lakes Region, WQO, EPA. Cleveland, Ohio. 10 p.

The most recent advance in the art of sewage treatment is the application of physical-chemical technology to raw sewage treatment. It is now an alternative to conventional treatment, especially for situations where significant phosphorus removal is required. Several studies have been made utilizing polymer addition to existing primary plants followed by small-scale pilt carbon absorption. One such study was done at the 10 MGD primary facility at Rocky River, Ohio. The result is good.

354. Kuh, P. G. 1966. Cleaning up the Great Lakes: How to do the job. Univ. Mich. Great Lakes Res. Div. Proc. 9th Conf. on Great Lakes Res. Great Lakes Res. Div. Pub. 15:446-450.

Two aspects of the Federal program for water pollution abatement are emphasized--enforcement and comprehensive water quality programs--and the ways in which they work together. With proper leadership and with widespread support from the community, this joint effort promises to make the Great Lakes a sensational demonstration ground of farsighted management to preserve water resources. A brief history is given of the legislation enacted to provide Federal assistance for the task of finding, developing, and maintaining suitable water quality throughout the United States. The enforcement provisions of the Water Quality Act of 1965, which amends the Federal Water Pollution Control Act are explained. The four enforcement actions on the Great Lakes are sketched: one on the Michigan waters of Lake Erie, one on the Cleveland area of Lake Erie, one on the Buffalo area of Lake Erie, and one on the southern end of Lake Michigan. These cases have been pioneering cases.

Pollution problems of the Great Lakes are more difficult in many respects than those of flowing rivers, because

they concern dense concentrations of industry and population which discharge huge volumes of waste effluent into rather small sections of the Lakes. New solutions pioneered in the Great Lakes cases have been criteria for maximum allowable concentrations of pollutants that damage water quality.

Kumnick, L. R. - See: H. F. Elkin, No. 210.

Kupiec, A. R. - See: D. G. Bardarik, No. 82.

355. Lake Erie Enforcement Conference Technical Committee. 1967. Report of the Lake Erie Enforcement Conference Technical Committee. Lake Erie Enforcement Conf. Tech. Comm. 29 p.

The report concluded that: silts containing nutrients are being contributed to the lake from dredging operations, urban and agricultural runoff, and shore erosion; wind-driven currents transport nutrients and silt over wide areas of the lake; phosphorus entering the lake originates from municipal wastes, rural land runoff, and industrial wastes; a rise in air and water temperatures has contributed to changes in the aquatic environment. (CE)

356. Lamb, J. C. 1969. A plan for ending Lake Erie pollution. Public Works. 100(6):79-82.

Although Lake Erie is the most sensitive of the Great Lakes to pollution from wastewaters, it is also the most amenable to corrective measures because of its relative small volume, rapid flush out time and high volume of excellent quality water from the Lake Huron. This report summarizes the findings of a comprehensive study initiated in 1963 by the division of Water Supply and Pollution Control of the U.S. Public Health Service and continued after 1965 by the Federal Water Pollution Control Administration. It describes pollution problems of Lake Erie and recommends a plan of action for stopping and ultimately reversing degradation of its water quality. (UB)

Lamont, C. - See: G. D. Simpson, No. 513.

357. Landis, H. 1968. Legal control in Canada or pollution in the Great Lakes drainage basin. Proc. of Great Lakes Water Resources Conf. Toronto, Canada. Paper U-7, no. 31868. pp. 155-200.

Ontario Water Resources Commission Act contains legal controls for the maintenance or improvement of water quality in the Great Lakes Basin and the prohibition, control and regulation of waste inputs affecting such quality. Exclusive provincial legislative power under the BNA Act are broad enough to enable Ontario to legislate effectively for these purposes. (UB)

Lane, R. K. - See: J. P. Bruce, No. 122.

358. Lane, R. K. Undated. Waste heat inputs to the Great Lakes of North America. Dept. Env. Canada Centre for Inland Waters. Burlington, Ont. Reprint 190. 13 p.

Thermal inputs in the Great Lakes were reviewed. Concern about the effects of population growth upon the deteriorated water quality of the Great Lakes was discussed. (UB)

359. Langlois, T. H. 1964. Lake Erie: Progress towards disaster. In: J. R. Dymond (Ed.), Fish and Wildlife. Longmans Canada Ltd., Don Mills. Toronto, Ont. 9 p.

Brief summary of facts about Lake Erie is presented to facilitate comprehension of the conditions which are responsive to the process of change, and to give cogency to the proposals with which this paper ends, namely that the results of extensive researches on the geology, limnology and biology of Lake Erie be applied towards solution of problems of fish management, shore-line stabilization and transportation-navigation.

360. Langlois, T. H. 1965. Ecological processes at a section of shoreline of South Bass Island, Lake Erie. Ohio J. Sci. 65(6):343-352.

The tombolo at the northeastern end of South Bass Island, and a contiguous till bank on the southeastern shore were studied between 1936 and 1963. The bar of the tombolo represents the line of convergence of waves from the east which had passed on both sides of the dolomitic outcrop at the outer end of the bar. Waves from the west, approaching the bar at right angles, brought to it materials from both sides. Changing levels of Lake Erie alternately submerged and exposed the bar for prolonged periods. During periods of exposure, many plants appeared, which were subjected to overriding sheet-ice and then were eliminated by subsequent prolonged submergence. The adjacent till bank receded by a combination of the

effects of shoving ice, frost, rain, waves, and winds (dehydration and sand-blasting). Boulders which washed out of the till bank were moved by waves and ice and accumulated near the landward end of the bar. These changes are illustrated by a set of dated photographs.

361. Langlois, T. H. 1965. The waves of Lake Erie at South Bass Island. Ohio J. Science. 65(6): 335-343.

South Bass is an island with a two-lobed outline near the southwest end of Lake Erie. It is composed of eastward-dipping dolomite rock. Wave erosion has produced high cliffs, characterized by spurs alternating with coves, which often have small pebble beaches, on the west shore, while low rock ridges separated by banks and beaches occur on the east. Locally on the west, large fallen blocks of dolomite partly protect the cliffs from the waves. On the east shore, flotsam is one of the major factors affecting the nature of the shoreline. Waves are locally dampened by masses of tape grass and, in winter, by water heavy with snow-curds and slush-balls. Cusps and cones of ice and splash-ice structures are also formed on shoals by winter waves.

Lanighan, M. C. - See: J. Puleo, No. 468.

Lawhead, H. F. - See: T. M. Patterson, No. 452.

362. Lawhead, H. F. 1965. Regulation of water levels in Great Lakes. Am. Water Works Assoc. J. 57(6):715-21.

Salient features of the system are indicated, variations in lake levels are discussed and problems of regulating lake levels are examined; plans for regulation of Lakes Michigan, Huron and Erie in each case include enlargement of outlet channel to provide increased discharge capacity and gated control structure to provide for flow reductions.

363. Lawrence, W. C. and M. M. Braidech. 1937. Cleveland's experimental pilot plant at Baldwin Filters. Water Works and Sewage. 84(4):142-145.

Development and description of an experimental water treatment plant of Cleveland, Ohio for the study of taste and odor removal and dechlorination with granular carbons are reported. (BECPL)

Lazarchik, D. A. - See: W. W. Aultman, No. 72.

364. League of Women Voters. 1966. Lake Erie: requiem or reprieve? Lake Erie Basin Comm. Bay Village, Ohio. 47 p.

A study of Lake Erie problems; pollution; floods, lake levels, and controls; clean-up programs and preventative measures. (BECPL)

365. League of Women Voters. 1970. Interim report on thermal and radiological effects being introduced to Lake Erie from electric power plants. League of Women Voters. Lake Erie Basin Comm. Bay Village, Ohio. 23 p.

Information regarding thermal and radiological effects which may be introduced to Lake Erie, particularly from power plants, was reported. The report also contains 10 specific recommendations for urgent action to meet specified water quality standard and to devise programs for achieving them.

366. League of Women Voters. 1974. Drilling for oil and gas in Lake Erie: development or destruction? League of Women Voters. Lake Erie Basin Comm. Bay Village, Ohio. 4 p.

Recent events are compelling industrialized nations to reassess present uses of energy and to seek new sources of supply. Proponents of development of fossil fuel resources in the underwater lands of Lake Erie have renewed efforts to lift the several state-ordered bans which prohibit drilling for oil or gas in the U.S. portion of the Lake.

367. Lednum, E. T. 1912. Livingstone Channel, Detroit River. Eng. News. 67(22):1037-1042.

The comparatively narrow deep water channel in the Detroit River, connecting Lake Erie with the upper lake causes a congestion of traffic of the larger steamers and has some dangerous points at which a number of accidents have occurred. To give greater depth and width for the modern large vessels, a new channel is being made in the river and is approaching completion. This is nearly 12 miles long and 300 to 450 ft. wide, with 22 to 24 ft. of water depth. Part of the works is done under water by drilling, blasting and dredging the rock. This paper gives a general description of both the submarine work and dry work. (BL)

368. Lee, C. E. 1961. Groins on the shores of the Great Lakes. J. of the Waterways and Harbors Div. A.S.C.E. Proc. Paper 2819. 87(WW2):89-111.

Groins are important structures in the protection and improvement of the shore. However, they are not a cure-all for shore erosion problems, as faulty design or misplacement of a groin can create additional problems or increase existing problems. Herein is included a summary of factual data on existing groins, of changes in lake levels, and other processes (the understanding of which is requisite to design), notes on design of groins for the Great Lakes, and some indication of research and costs. (BECPL)

369. Lee, C. E. 1962. Groins on the shores of the Great Lakes-Closure. J. of Waterways and Harbors Div. Proc. A.S.C.E. 88(WW2):157.

Closure of the discussion on the original paper--Groins on the shores of the Great Lakes, by C. E. Lee. Proc. Paper 2819--is given in this report. Further discussion on the equation used in the groin design is made briefly. (CE)

Lee, K. K. - See: J. A. Liggett, No. 380.

370. Lee, K. K. and J. A. Liggett. 1970. Computation for circulation in stratified lakes. J. of Hydraulics Div. Proc. A.S.C.E. 96(10):2089-2115.

A mathematical method is developed for calculating the steady state three dimensional wind driven circulation in a large stratified lake of arbitrary bottom topography and shape on a rotating earth. The stratification is modeled by a two-layer structure in which the hypolimnion and the epilimnion are considered as two distinct layers with different densities and eddy viscosities. The thermoclines location responds sensitively to the applied wind stress and has an important effect on the circulation velocity. An off shore wind is the primary cause of the cold water up-welling near the shore due to the movement of thermocline. The surface current velocity generally has a smaller magnitude and greater deflection angle than in the homogeneous case except near the boundaries. The volume transport is strong and in the downwind direction near the shore in the epilimnion and near the deep center in the hypolimnion. (BECPL)

371. Lee, T. R., T. E. Borton, R. O. Brinkhurst, D. Connor, K. E. McElroy, Jr. 1971. Symposium: Public involvement in the water management problems in the Great Lakes. Internat. Assoc. Great Lakes Res. Proc. 14th Conf. Great Lakes Res. pp. 731-737.

Public participation in government decision making has a long tradition in North America. Yet, in recent years, there has been considerable public outcry against the "arbitrary decisions" of government and pressure for increased public involvement in the planning process. There is demonstrably a need to develop a genuine partnership between the water resource planner and the water resource public. There is really no option as to whether to involve the public or not but only as to how to develop most effectively public involvement. Examples are drawn from the experience of the Great Lakes Basin Commission, the Susquehanna Study of the U.S. Corps of Engineers and the Canada-New Brunswick St. John River study. The evolution of one non-governmental public involvement institution, Pollution Probe, at the University of Toronto, is discussed and its aims related to the issue of the public participation in problems of resource management and environmental quality.

Leland, H. V. - See: S. S. Shukla, No. 509.

372. Levy, A. F., S. C. Simmermacher and L. A. Marshall. 1943. A quarter century of development in Cleveland's water supply. Am. Water Works Assoc. J. 35(7):869-899.

During the last quarter of a century the Cleveland area has witnessed one of the greatest water supply developments in its history. This report consists of three parts. General development of system is described by Levy. Progress in pumps and pumping stations are reported by Simmermacher. And the detail description of Baldwin Filtration Plant is given by Marshall. (BL)

Lewis, C. F. M. - See: G. D. Hobson, No. 306.

373. Lewis, C. F. M. 1969. Late quaternary history of lake levels in the Huron and Erie Basins. Internat. Assoc. Great Lakes Res. Proc. 12th Conf. Great Lakes Res. pp. 250-270.

Sediments in several small lakes on Manitoulin Island contained two units of low-energy organic gyttja accumulated between 10,000 and 6,000 BP; the upper from about 4,000 BP to the present. These sediments document a history of emergence, submergence, emergence and correlate with low level Lake Stanley, the Nipissing transgression and the post-Nipissing emergence, respectively, in the Huron basin.

The Nipissing Great Lakes reached their maximum level about 5,500 BP (on Manitoulin Island). By 4,700 BP the Nipissing drainage completely transferred from the North Bay outlet to southern outlets. Nipissing levels were maintained in the south for an additional 800-900 years while uplift and emergence proceeded in the north.

Piston core and echogram data revealed a series of small basins within western Lake Erie beneath post-glacial clayey silt mud. Each basin contained an extensive bed of plant detritus suggesting the previous existence of a marsh environment. The marsh deposits ranged in age from 12,600 to 5,000 years BP. These data with information on differential warping of the Erie basin yielded a revised history of post glacial lake levels. Early Lake Erie, following an episode of glacial lake drainage, came into existence 12,600 years BP, at 40 m below present lake level. This low level phase was shortlived as rapid post-glacial rebound raised the outlet at Buffalo. Levels were maintained near 15 - 10 m from 10,000 - 6,000 BP. A sharp rise between 5,000 and 3,800 years BP is correlated with the transfer of Nipissing drainage through Lake Erie. A slow but progressive rise is inferred to the present day.

374. Lewis, C. F. M., T. W. Anderson and A. A. Berti. 1966. Geological and Palynological studies of early Lake Erie deposits. Univ. Mich. Great Lakes Res. Div. Great Lakes Res. Div. Pub. 15:176-191.

Coring and echo sounding of Lake Erie bottom sediments have indicated a thin lag concentrate of sand, in places with plant detritus, pelecypods, gastropods and other fossils, underlying recent silty clay muds and overlying clay till or late-glacial lacustrine clays. Buried shallow pond organic sediments in the western basin and relict beach deposits, wave-cut terraces and intrabasinal discharge channels in the central basin, some of which are buried, all indicate former low water levels in central and western

Lake Erie much below those at present. This evidence, combined with radiocarbon dates of 10,200 and 11,300 years B.P. on the organic material and information from nearby regions, suggests that Early Lake Erie came into existence about 12,400 years ago, with water levels, 100 ft. (30 m) lower than at present, at approximately 470 ft. above sea level. From this stage lake levels rose rapidly as the outlet area at Buffalo, N. Y., was uplifted isostatically following deglaciation, and probably reached their present elevation 9,000 to 10,000 years ago.

Examination of the cores indicated that pollen is sufficiently abundant and well preserved in the sediments for palynological studies. Pollen diagrams can be correlated with one another, and with those outside of the Lake Erie basin. The presence of a legible pollen record indicates that sedimentation has been probably continuous and undisturbed at the sites investigated since low-level Early Lake Erie. Palynological studies support the geological evidence of a low lake stage and provide a means for dating and correlating sediment sequences which do not contain enough organic matter for radiocarbon analysis.

Lewis, E. W. - See: P. E. Chase, No. 143.

375. Li, T. Y. 1970. Formation of thermocline in Great Lakes. Internat. Assoc. Great Lakes Res. Proc. 13th Conf. on Great Lakes Res. pp. 453-467.

In the present study the termal structure and dynamic conditions in the lake are analyzed, based on conservation equations of turbulent mean motion. Under windy conditions, vertical convection and mixing become important for the thermocline problem. While the horizontal motion of the lake water is described by the general Ekman type equations, the vertical mode motion is governed by equations of the form of Burgers' model equation of turbulence. Solutions are obtained which provide theoretical estimates of the formation of thermocline in Great Lakes.

376. Li, T. Y. 1971. Maintenance of thermocline in a stratified lake. Internat. Assoc. Great Lakes Res. Proc. 14th Conf. on Great Lakes Res. pp. 582-592.

In determining the equilibrium thermal structure of the Great Lakes one must deal with the nonlinear interplay between the wind and the sun. The wind produces diffusive turbulent motions and the solar heating causes nonuniform temperature structure. This nonuniform temperature in the water brings forth important effects of buoyancy force. The equations of motion to the Boussinesq approximation are adopted in the present paper. An integral equation is obtained which represents the condition of energy balance among (1) kinetic energy input from the wind, (2) potential energy from the buoyancy force, and (3) viscous dissipation. Another integral equation is obtained which represents the condition of thermal energy balance, including solar heating energy. These two integral equation are solved simultaneously to provide a rational estimate of the equilibrium thermocline depth in a stratified lake.

377. Li, T. Y. 1973. Some natural physical processes affecting the recovery of the Great Lakes. Proc. 19th Ann. Tech. Meeting of the Inst. of Env. Sci. pp. 416-423.

If the introduction of pollutants into the Great Lakes can be completely shut off, the lakes would then undergo many natural processes of self-improvement such that their restoration to pristine condition becomes possible at a future time. These natural self-purging processes in the lakes include physical, chemical and biological processes. The present paper reviews some important physical processes that affect the self-improvement of the lakes.

378. Libby, R. W. 1964. Methods and facilities for conducting water quality studies in the Great Lakes. Univ. Mich. Great Lakes Res. Div. Great Lakes Res. Div. Pub. 11:100-109.

Included is a discussion of the methods and facilities utilized for collecting representative samples suitable for water quality analyses in the Great Lakes. The subjects presented are the types of lake samples collected; descriptions of the vessels employed by this project; the work necessary to plan a cruise; a brief description of some common devices used to procure samples; a breakdown of the samples taken in each study area and a listing of the various chemical, biological, bacteriological and radiochemical analyses made on the samples; and a discussion of the physical measurements made aboard ship.

Lick, W. - See: R. T. Gedney, No. 258.

Lick, W. - See: R. T. Gedney, No. 259.

Lick, W. - See: R. T. Gedney, No. 260.

Lick, W. - See: R. T. Gedney, No. 261.

Lick, W. J. - See: J. F. Paul, No. 454.

Lick, W. J. - See: Y. P. Sheng, No. 508.

379. Liddell, D. M. 1969. Surge problems in canals with high-lift locks. J. of Waterways and Harbors Div. Proc. A.S.C.E. Proc. Paper 6898. 95(WW4): 467-490.

A study is currently being made to develop a plan, including the costs and benefits, of a Lake Erie-Lake Ontario Waterway. This canal would provide a deep draft waterway between Lake Erie and Lake Ontario and be entirely within the United States. The waterway would follow the Niagara River for about 15 miles and then utilize a 600-ft. wide overland canal of 17 miles to 25 miles in length, depending on the route. A lock with a 5-ft. lift would replace the existing Black Rock Lock in the river section. The total drop in the overland section would be about 320 ft. Lock dimensions being considered are 110 ft. wide by 1,200 ft. long with lifts of 107 ft., 80 ft., or 64 ft., depending on the number of locks. To reduce turbulence and mooring line stress on ships within the lock chamber, a filling and emptying system utilizing bottom longitudinal distribution laterals has been designed. The movement of this volume of water in or out of a 600-ft. wide canal section presented the possibility of some very serious surge problems. This paper examines the magnitude of these problems and a description of the possible solutions considered. A number of surge conditions at existing locks have been reviewed to determine the magnitude of the surges and the type of improvement or operation used to reduce the problem to acceptable limits. A description of some of these prototype problems and solutions is also included. (BECPL)

Liggett, J. A. - See: K. K. Lee, No. 370.

380. Liggett, J. A. and K. K. Lee. 1971. Properties of circulation in stratified lakes. J. of Hydraulic Div. Proc. A.S.C.E. Paper 7793. 97(HY1):15-29.

An approximate method is presented to display some features of wind driven circulation in a stratified lake. Rotation of the earth is included but the effects of bottom topography and shoreline configuration are ignored. The results indicate that the free surface slopes upward in the down wind direction and upward to the right of the wind (in the northern hemisphere) whereas the thermocline has the opposite slope. These slopes decrease with increasing epilimnion thickness. The assumption of higher eddy viscosities also increases slope, but decreases the velocities in the epilimnion. Decreased epilimnion velocities result from a smaller epilimnion thickness.

381. Limnos. 1969. Air cushion vehicle helps study water pollution in joint effort. Limnos. 2(2):26.

A United States aerospace company and the Canadian government joined forces recently in a winter water pollution study utilizing an air cushion vehicle (ACV) for transportation on ice-bound Lake Erie. The program was designed primarily to establish the feasibility of using an ACV for transporting scientists and their equipment across the frozen lake to water sampling stations; thereby, enabling the Centre to extend its studies through the winter months.

382. Limnos. 1970. An industrial view: what on earth is pollution? Limnos. 3(4):11-17.

In Dr. Pecora's discussion of Lake Erie, he views the lake's situation as a natural aging process. He says saving Lake Erie is hardly the issue; he sees our real conflict as the need to develop the earth's resources and the desire to preserve the earth's environment.

383. Limnos. 1972. The situation lake by lake. Limnos. 5(1):18-23.

The article summarizes principal pollution problems of major problem areas in Great Lakes. For Lake Erie, the Cuyahoga River has most pollutants from municipal waste treatment plants and industries. The Maumee River has 25% of Lake Erie's silt loading and 15% of its phosphorous load. The Detroit River has 58% of Lake Erie's phosphate load.

384. Limnos. 1973. Seiches regulation and evaporation. Limnos. 5(3):16-17.

Lake Erie is the most susceptible of the Great Lakes to seiches primarily because its long axis is nearly parallel to the prevailing wind direction.

Linsley, K. L. - See: K. L. Mick, No. 411.

385. Liu, P. C. 1970. Statistics of Great Lakes levels. Internat. Assoc. Great Lakes Res. Proc. 13th Conf. Great Lakes Res. pp. 360-368.

Records of monthly mean water levels are available for the Great Lakes from 1860 to the present. The probability distribution of annual as well as monthly mean water-level data is substantially Gaussian, with the exception of monthly Lake Michigan-Huron data. However, a modified Gaussian distribution using the successive terms of a Gram-Charlier series improves the representative of the data of all the Lakes, including Lake Michigan-Huron. The average and probability distribution are essentially independent of time, although some standard deviations vary with time. Furthermore, the long-term linear trend of these data was found to be insignificantly small, and the time series can be considered as weakly stationary in a broad sense.

Spectral analysis of monthly water-level data in the frequency range between zero and six cycles per year reveals that significant peaks of annual cycles exist in all the Lakes. Spectra obtained by taking differences between the monthly data and the long-term average for the same months, on the other hand, do not contain any prominent peaks. Spectral analysis of annual water-level data in the frequency range between zero and one-half cycles per year suggests the existence of a long-term periodic cycle of eight years.

386. Liver, N. L., E. C. Mardorf and J. C. King. 1954. Mixed-in-place piles from jetty to control beach erosion. Civil Eng. (NY). 24(3):56-57.

In order to prevent beach erosion at Camp Perry, Ohio, a jetty was built out into Lake Erie by drilling mixed-in-place piles in overlapping chains through center of a sand-fill, built by clamshell. Construction procedures are described. Unit can work to depths of 30 ft. 120 ft. jetty carries roadway of 12 ft. wide from which pile mixing rig operates. (UB)

387. The Lorain Port Authority. 1964. Plans for the Port of Lorain. The Lorain Port Authority. Lorain, Ohio. 11 p. and map.

The existing navigation improvements at Lorain Harbor comprise of: a channel from Lake Erie through the outer harbor to a point in the river channel 2,200 feet upstream from the outer ends of the river piers with a controlling depth of 28 feet; a maneuvering area in the outer harbor with the same depth; the river channel from 2,200 feet upstream of the outer ends of the river piers to 2-1/4 miles upstream to the head of navigation with a controlling depth of 27 feet; a turning basin at the upstream limit of navigation with a controlling depth of 21 feet; a turning basin midway up the Black River with controlling depth of 20 ft.; and an approach to the Municipal Pier with a controlling depth of 16 feet. The U.S. Army Engineer District, Buffalo, New York, has formulated a project for improvements now being implemented. (CE)

388. Luck, A. D. 1967. Lake Erie--A study in resource geography. M.S. Thesis. Department of Geog. Norman, Oklahoma. 79 p.

The task undertaken is the consideration of Lake Erie as a natural resource, and the examination of its "depletion and conservation" over a considerable period of time. The study includes both the major causes and effects of water pollution in the Lake. These causes and effects are not only derivatives of modern human environment, but also to an increasing extent determinants of that environment.

Lynde, G. A. - See: F. H. Forney, No. 237.

Lynde, G. A. - See: L. W. Olmstead, No. 442.

Lyons, W. A. - See: W. W. Aultman, No. 72.

Lyons, W. A. - See: H. S. Cole, No. 159.

389. Lyons, W. A. 1968. Water conflicts on Lake Erie. In: Proc. of Great Lakes Water Resources Conf. June 24-26, 1968. Toronto, Canada. pp. 115-119.

The water quality problems of Lake Erie are due to excessive pollution, particularly over fertilization of the lake and exploitation of the fisheries resource, without consideration for a favorable fish balance. Public statements about the lake's death are overly pessimistic and tend to depress the recreation and tourist economy of the lake. Improvement in water quality of the lake should be taken in three steps:

1. Implementation of the pollution abatement program developed by the Federal Conferees and the International Joint Commission.

2. Development of a conceptual policy framework based on a model of the lake which considers ecologic, hydrologic, and biochemical and other subsystems operative in the lake and relates pollution abatement to resultant water quality and use improvements including costs.

   The feasibility of removing trapped sediments should be considered as part of such a model.

3. Improvement of fisheries.

390. Lyons, W. A. 1970. Numerical simulation of Great Lakes summertime conduction inversions. Internat. Assoc. Great Lakes Res. Proc. 13th Conf. on Great Lakes Res. pp. 369-387.

Warm air advection over the Great Lakes during early summer often occurs with air-water temperature differences as large as 30°C, resulting in shallow, but intense, inversions from downward conductive transport. A computer program is developed to solve the heat transfer equation. Temperature profiles of advecting air columns are calculated as functions of fetch and time from these input parameters: water surface temperature, hourly land air temperatures and lapse rates, wind speed, and an estimated eddy conductivity coefficient. This last term is considered to be a constant above the 2 m level.

The computed temperature profiles are used successfully to reconstruct a wiresonde cross section across Lake Michigan. The layer experiencing conductive cooling greater than 1°C rarely exceeds 75-100 m. In other cases, extreme inversions of 15°C/50 m are computed and confirmed by observation. Daytime superadiabatic layers over land are found to be eradicated and replaced by a stable layer within a 10-20 km fetch.

391. Mackay, W. R. 1968. Commercial navigation on the Great Lakes. In: Proc. Great Lakes Water Resources Conf. Toronto, Canada. Paper U-3, No. 29157. pp. 89-114.

Growth of commercial navigation in the Great Lakes and St. Lawrence system is traced from its inception to the present, and the relationship which the development of the canals has borne to its development and growth is outlined. Indicated for the future are the possibilities for expansion through the development of the potash deposits in Saskatchewan combined with the ever-increasing grain, coal, and iron ore traffic and the expansion of overseas trade. 14 references. (UB)

Mackenzie, R. J. D. - See: G. C. Dohler, No. 202.

392. MacLaren, J. W. and R. F. Clevenger. 1968. New requirements in water resources planning on the Great Lakes. In: Proceedings of Great Lakes Water Resources Conf. June 24-26, 1968. Toronto, Canada. pp. 361-391.

The paper refers to present conditions on the Great Lakes, including the complexity and inter-effect of the various uses of the resource.

It discusses at length the type of action that will be required to introduce appropriate planning to permit the optimum development of the resources on both sides of the border.

Recommendations are then made for the organizational procedures necessary to implement the study and the plan, including reference to the roles of the recently established Great Lakes Basin Commission and the continuing role of the International Joint Commission.

393. MacLean, W. F. 1963. Modern pseudo-upwarping around Lake Erie. Univ. Mich. Great Lakes Res. Div. Collected Reprints. 1:425-435.

Previous rates of modern crustal movement have been calculated by comparing gage differences of pairs of water-level gages over a number of years despite the fact that Lake Erie is southwest of the zero isobase of the Nipissing shoreline; thus Lake Erie is in an area where postglacial

rebound ceased by Nipissing time (3500-4200 years B.P.)

An analysis of errors and factors influencing water-level gages and a correlation study of Lake Erie effective winds versus gage differences demonstrated that the quantities which were measured as rates of crustal movement from gage difference--time curves were actually slopes of the lake surface measured from best-fit curves of net summer season set-up.

Mardorf, E. C. - See: N. L. Liver, No. 386.

Mark, H. B. Jr. - See: J. S. Mattson, No. 397.

394. Marsh, J. A. 1956. Nottingham Filtration Plant adds third link to Cleveland supply. Water Works Eng. 109(5):446-448.

Nottingham Filtration Plant's 100 mgd system provides central instrumentation control of all pumping and treatment stages. Sludge is removed semi-annually. Rate of flow controllers and master control hand wheels are discussed briefly. (BECPL)

395. Marshall, E. W. 1966. Air photo interpretation of Great Lakes ice features. Univ. Mich. Great Lakes Res. Div. Special Rept. 25. 92 p.

The report collects visual imagery of ice features and patterns common to the Great Lakes and gives interpretations of it. The study is based on USAF aerial photography flown over the Great Lakes on March 23, 1963, together with observations and photographs taken on U.S. Coast Guard ice reconnaissance flights during January and February, 1965. Ice features are included from all Great Lakes with the majority from Lake Erie.

The photographs and interpretations are arranged according to features found in open water areas during freeze-up, in the newly formed ice, in winter ice and in patterns resulting from snow and wind.

The report brings out the role of snow and water turbulence in determining the types of ice sheet formed.

Recommendations are made for future research.

Marshall, L. A. - See: A. F. Levy, No. 372.

Martinek, F. - See: M. S. Hundal, No. 316.

Masters, C. O. - See: J. Puleo, No. 468.

Matheson, D. H. - See: D. V. Anderson, No. 7.

396. Matson, J. V. and G. F. Bennett. 1969. Cost of industrial and municipal treatment in the Maumee River basin. Chemical Eng. Progress Symposium Series. Paper 43138. 65(97):100-5.

The present and future costs of wastewater treatment in the Maumee River basin were balanced against the benefits accruing from improvements in water quality for various degrees of treatment of industrial and municipal effluents, to determine the optimum benefit-cost point. A comprehensive program including secondary treatment of all effluents, tertiary treatment for a number of cities on critical stream stretches, and a phosphate removal program, provided the economic optimum. At that point, the benefit-cost ratio approached unity. 10 references. (UB)

397. Mattson, J. S. and H. B. Mark Jr. 1969. Application of internal reflectance spectroscopy to water pollution analyses. Env. Science & Tech. Paper 13789. 3(2):161-4.

More rapid than conventional techniques which require homogeneous transparent solutions, internal reflectance spectrometric technique was used to identify organic components of optically opaque materials including solid materials in cigarette smoke, water containing blue-green algae, and Lake Erie mud bottoms. (UB)

398. McBride, G. A. 1949. Treatment of wastes in metal working plant--Discussion. Sewage Works J. 21(3):509-511.

Discussion is made on Unwin's paper-treatment of wastes in metal working plant. Industry wastes has prolonged effect on pollution problem. Thus treatment is required. Unwin's method is reviewed. (BECPL)

McCafferty, T. F. - See: E. L. Pucel, No. 467.

399. McClain, E. P. 1972. Environmental monitoring of the Great Lakes from space. Proc. 1st Federal Conf. on the Great Lakes. Interagency Comm. on Marine Sci. and Eng. pp. 197-201.

The national Environmental Satellite Service of NOAA conducts research in the area of oceanographic and hydrologic applications of Earth satellite data through its Environmental Sciences Group. Although the data used in this research are acquired chiefly from NOAA's own operational environmental satellites, observations from NASA's Nimbus, Applications Technology, and Earth Resources Technology satellites have been used extensively also. The measurements from the recently launched NOAA-2 and ERTS-1 satellites are much more useful than those from previous spacecraft for studies in areas like the Great Lakes because of the higher spatial and spectral resolution of these new data. ESG's research in the Great Lakes area includes the development of satellite data display and analysis techniques for monitoring surface temperature fields, ice cover conditions, circulation patterns, and Basin snow cover. Part of this work is being done in connection with the IFYGL.

400. McDonald, W. E. 1959. Deep-draft navigation on the Great Lakes. J. of the Waterways and Harbors Div. Proc. A.S.C.E. Proc. Paper 2298. 85(WW4):29-37.

This paper describes the character and scope of studies undertaken by the Corps of Engineers, U.S. Army, for the present program for deepening the Connecting Channels and harbors to serve adequately the modern bulk cargo vessel fleet on the Great Lakes and also to determine navigation improvements required at Great Lakes harbors to accommodate vessel traffic through the St. Lawrence Seaway. These studies are the latest of a continuing effort in response to Congressional directives to the Corps of Engineers in determining the nature and extent of additional improvements warranted in the public interest to effect the maximum net benefits from waterborne commerce on the Great Lakes. (CE)

McElroy, K. E. - See: T. R. Lee, No. 371.

McFadden, J. T. - See: J. M. Armstrong, No. 66.

401. McKnight, A. L. 1965. Dredging--past, present, and future. In: Coastal Eng. Santa Barbara Specialty Conf. October, 1965. pp. 727-747.

This paper traces the history of dredging from a primitive dredge invented by Leonard da Vinci to the most modern and powerful equipment. Emphasis is given to the modern hopper dredge and recent development in connection with the use thereof. The possibility of applications of hopper dredges to beach nourishment work is discussed with an account of current experiments being made in an effort to develop the practicability of such usage. (UB)

402. McLaughlin, A. J. 1914. Sewage pollution of Boundary Waters. Proc. Am. Water Works Assoc. 1:24-30. (BL)

This paper gives results of a sanitary survey of the Great Lakes and boundary rivers. Some remedies are suggested to solve sewage pollution problems. (BL)

McLay, R. W. - See: M. S. Hundal, No. 316.

403. McLean, E. O. 1970. Agricultural pollution of Lake Erie. Ohio Report. Res. Development. 55(4):94.

Studies have been designed to supplement field investigations of movement of plant nutrients and other agricultural chemicals through the soil and out of tile drains. Compared to most other plant nutrients in the soil or added to it as fertilizers, phosphorus is least free to move about in the soil.

McVehil, G. E. - See: R. A. Brown, No. 117.

404. McVehil, G. E. and R. L. Peace, Jr. 1965. Some studies of lake effect snowfall from Lake Erie. Univ. Mich. Great Lakes Res. Div. Proc. 8th Conf. Great Lakes Res. Div. Pub. 13:262-272.

Analyses have been made of a number of recent cases of lake-induced snowfall along the southern and eastern shores of Lake Erie. Synoptic analyses are presented which show the large-scale weather situations in which severe lake effect snowstorms occur, and also some of the mesoscale features of the snow squall bands.

Radar photographs taken from the U.S. Weather Bureau radar

at Buffalo have been analyzed to show the frequency of occurence of the banded convective precipitation from the lake and the characteristics of the precipitation patterns. The results indicate that lake effect snow occurred on over 21% of all days during November, December, and January of the past three years and that there are several characteristic snowfall patterns.

Rates of heat transfer and evaporation from Lake Erie to the cold polar air masses in which lake effect storms occur have been estimated from synoptic radiosonde data. Results of the calculations are presented along with comparisons with other estimates.

Megerian, E. - See: B. G. DeCooke, No. 191.

405. Megerian, E. 1964. Forecasting Great Lakes levels second through sixth month. Univ. Mich. Great Lakes Res. Div. Proc. 7th Conf. Great Lakes Res. Div. Pub. 11:238-252.

This paper is an extension of one presented at the Fourth Conference of Great Lakes Research, titled "Forecasting Great Lakes Levels," in which a method for forecasting end-of-month levels for six months was presented. The method presented in the afore-mentioned paper for forecasting the second through the sixth month gave satisfactory results when meteorological conditions were within their normal limits; however, under persisting adverse conditions, which result in abnormal net basin supplies, a more functional determination of these supplies was deemed desirable. The method presented in this paper assumed that conditions on the Great Lakes are changing periodically; consequently, the hypothetical normal values are also changing. Hence, the most probable amount of net basin supply can be determined on a monthly or yearly basis utilizing trend analysis.

406. Megerian, E. and R. L. Pentland. 1968. Simulation of Great Lakes basin water supplies. J. Water Resources Res. 4:11-17.

The basic concept utilized in the simulation study is to evaluate statistically the recorded supplies to isolate the two components assumed to constitute the basin water supply: (1) that portion of the supply that is considered random, owing to chance interaction of unpredictable meteorological elements, and (2) that portion of the supply that

is the result of the persistence due to natural storage in the lakes, soil, bedrock, and snow over the drainage basin. In this study, consideration was also given to the relationship between supplies in Neighboring basins. These factors were used to formulate mathematical models for simulation of supplies to all of the Great Lakes simultaneously. Extensive statistical tests have been used to ensure that the statistical parameters and the time series characteristics of the simulated data resemble those of the recorded data.

Meredith, D. D. - See: L. B. Buetikofer, No. 128.

Meredith, D. D. - See: D. M. A. Jones, No. 340.

407. Meredith, D. D. and B. B. Ewing. 1969. Systems approach to the evaluation of benefits from improved Great Lakes water quality. Internat. Assoc. Great Lakes Res. Proc. 12th Conf. Great Lakes Res. pp. 843-870.

A systems approach to the evaluation of benefits that would accrue due to an improvement in the quality of the water in the Great Lakes is outlined. The basic approach for analysis of municipal and industrial water supply, recreational use, and commercial fishing involves following a change in water quality through a sequence of interrelationships to arrive at an estimate of annual benefits. The difficulties encountered in determining the benefits are discussed. A mathematical model which can be solved to determine the benefits for a change in water quality when the level of water quality before and after the improvement is known is presented in the appendix. The model is applicable to all uses.

Merkle, H. K. - See: G. D. Simpson, No. 511.

408. Merna, J. W. 1962. Quantitative sampling with the orange-peel dredge. Limn. and Oceanog. 7(3):432-3.

The U.S. Bureau of Commercial Fisheries has used the orange-peel dredge extensively in the Great Lakes, as it is the only dredge presently available that operates in hard clay or gravel. This was a study to determine the sampling area of the orange-peel dredge in various bottom types. Under laboratory conditions, the surface area sampled increased with depth of penetration of the dredge from about 65 square inches, at a depth of 1 inch to about 138 square inches at 5 inches. Further increase of penetration to 6 inches did not increase the area. (UB)

409. Merrow, A. S. 1970. Bethlehem Steel's waste water management problem at Lackawanna. Internat. Assoc. Great Lakes Res. Proc. 13th Conf. on Great Lakes Res. pp. 562-566.

The Bethlehem Steel Corporation has been concerned about the discharges of waste water to Lake Erie and instituted a program of flow measurement and analysis of waste streams from individual mill sewers in the 1950's. Realizing that improvements in discharge quality would be necessary, a consulting firm was retained in 1965 to make a complete survey of the waste discharges from the plant and propose plans for treatment of all waste waters.

The resulting recommendations were reviewed by the Lackawanna Plant Engineering and Fuel Departments and discussed with representatives from the New York State Health Depatment who were very cooperative in arriving at approved plans to cover treatment of all waste water discharges. This paper covers the development of the program, the engineering aspects, construction of the facilities and of the first two treatment systems which have been placed in service.

410. Michigan Department of Natural Resources. 1973. Flooding problems associated with current high levels of the Great Lakes. Water Development Services Div. Lansing, Mich. Mich. Dept. of Natural Resources. 46 p.

Reasons for high water, effects of current high water, what can be done under existing programs, and alternatives for future action are generally discussed.

411. Mick, K. L. and K. L. Linsley. 1957. Examination of sewage solids incineration costs. Water & Sewage Works. 104(11):479-87.

Discusses **comparison** of sewage treatment plant costs and accomplishments for Buffalo, NY, Cleveland Ohio, Detroit, Mich., and Minneapolis-Saint Paul, Minn., which all operate incinerators; comparison of sewage solids incineration and associated operating total disposal cost factors; sludge disposal construction costs.

412. Miller, G. S. 1968. Currents at Toledo Harbor. Internat. Assoc. Great Lakes Res. Proc. 11th Conf. Great Lakes Res. pp. 437-453.

An investigation of currents at Toledo Harbor, Ohio, was conducted from May through November, 1966, using Eulerian and Lagrangian techniques. The driving forces producing currents in the harbor are wind tides, seiches, and river discharge. The current is a reversing type except during periods of high river outflow. Speed histograms indicate that about 10% of the time the current speed is greater than 15 cm/sec. Spectral analysis of current speed shows the peaks correspond to the modes of the seiche. Drogue tracks indicate that the mid-channel current is up to 2.5 times greater than that recorded near the channel edge. Opposing currents are occasionally observed because of wind induced surface currents.

413. Miner, J. R., D. Bundy and G. Christenbury. 1972. Bibliography of livestock waste management. Office of Res. and Monitoring. U.S. Env. Protection Agency, Washington, D. C. Env. Protection Tech. Series EPA-R2-72-101. 137 p.

Included in the bibliography are references which include title author, key words and sources date for 241 journal papers, 425 papers published as conference proceedings, 114 university or government publications, 71 magazine articles, 26 books or book chapters, 15 unpublished papers and 53 academic thesis. Any one of these items may be identified and the reference located by knowing the author's name, title of the article or by checking the subject matter listing. (UB)

414. Mio, L. 1974. Sandbar threatens to wreck Mentor's boating. U.S. Army Corps of Engineers. Buffalo District. Buffalo, New York. 2 p.

A sandfilled channel threatens to wipe out the boating season at the Mentor Harbor Yachting club, unless $30,000 can be raised to dredge the 2,000-feet wide channel mouth and keep it open, during the summer. A proposal is made to solve the dredging problem. (CE)

Moffett, J. W. - See: A. M. Beeton, No. 90.

Mohler, E. F. Jr. - See: H. F. Elkin, No. 210.

Molls, F. B. - See: R. T. Gedney, No. 261.

Mundingers, P. C. - See: C. F. Powers, No. 465.

Murphy, D. L. - See: D. F. Paskausky, No. 451.

415. Murphy, T. E. 1970. Considered Lake Erie-Lake Ontario waterways: hydraulic model investigation. U.S. Army Engineer Waterways Experiment Station. Vicksburg, Mississippi. Tech. Rept. H-70-3. 14 p. + plates.

The investigation reported herein was conducted to assist the U.S. Army Engineer District, Buffalo, in determination of the economic justification of a water route connecting Lake Erie and Lake Ontario. Specifically, the studies involved determination of the most functional and economical location for a lock in the vicinity of Buffalo, N. Y., and an evaluation of navigation conditions at the entrance to an overland canal joining the American channel of the Niagara River northwest of North Tonawanda, N. Y. An existing model of the Niagara River with a horizontal scale of 1:360 and a vertical scale of 1:60 and a new undistorted model of the canal entrance with a 1:120 scale were used in the investigation. Tests demonstrated the desirability of placing the new lock in the vicinity of Buffalo as far downstream as is feasible without rendering the existing Black Rock Lock and Canal inoperable during the construction period. Navigation problems at the canal entrance were not as severe as had been contemplated and a small amount of overexcavation resulted in satisfactory conditions.

416. Murthy, C. 1971. An investigation of diffusion characteristics of the hypolimnion of Lake Erie. Internat. Assoc. Great Lakes Res. Proc. 14th Conf. on Great Lakes Res. pp. 799-804.

A dye patch diffusion experiment was carried out in early August to study large scale diffusion characteristics of hypolimnion waters in central Lake Erie. Experimental data were obtained by Fluorometric sampling, to define the peak concentrattion, horizontal and vertical spread of the dye patch at different times. The vertical spread of the patch was restricted to the hypolimnion because of the strong thermocline. The horizontal spread was an order of magnitude less, corresponding eddy diffusivity two orders of magnitude less, and the observed peak concentration was two orders of magnitude greater compared to surface layer diffusion for comparable time scales of the order of 60 hrs.

417. Murty, T. S. and D. B. Rao. 1970. Wind generated circulation in Lakes Erie, Huron, Michigan, and Superior. Internat. Assoc. Great Lakes Res. Proc. 13th Conf. on Great Lakes Res. pp. 927-941.

The wind-generated circulations in Lakes Erie, Huron, Michigan and Superior were computed using a steady state linear model with topography and rotation taken into account. This is a homogeneous model and is thus applicable to late fall and early spring situations only. The Lake Erie circulation pattern shows basically three cells. An elongated clockwise cell near the southern shore terminates at its western end in the shallow western basin. This cell becomes strong to the east of Erie and persists to midway between Silver Creek and Buffalo. The second cell is clockwise and is in the northern part of the lake. The third cell is clockwise and it is in the northeastern part of the lake. The circulation pattern in Lake Huron shows four cells. In the eastern part there is a strong counterclockwise cell. In the western part there is a clockwise cell. Most of Georgian Bay is occupied by an intense counterclockwise cell. There is a weak clockwise cell in the western part of the Georgian Bay. In Lake Michigan there are two cells: a clockwise cell in the western part and a counterclockwise cell in the eastern part. The circulation in Lake Superior is by far the most unorganized with generally counterclockwise motion in the southern portions and weak clockwise motions in the northern portions.

418. Myers, H. V., J. J. Gessner and T. G. Waring. 1972. Physical characterization of cooling water discharges into the St. Clair and Detroit Rivers. Internat. Assoc. Great Lakes Res. Proc. 15th Conf. on Great Lakes Res. pp. 635-641.

In the past few years, a great deal of controversy has arisen concerning the effect of so-called "once-through" cooling water discharges on receiving bodies of water and their biota. In order to determine the effects of a cooling water discharge, the location and movement of the discharge with respect to the receiving body of water must be known.

In the summer of 1970 and the spring of 1971, the thermal plumes from four power plants were characterized. Each year, thermal plumes from plants located on the St. Clair River and the Detroit River were studied. A thermal plume was defined as the cooling water discharge detected in the receiving

body of water by a measurable temperature difference. The characterization was to determine the spatial dimensions of the plume and to chart the thermal gradients along its path. This work was accomplished using a multiple thermocouple cable and a multipoint recorder to measure vertical temperature transects. Flourescent dye was used to define the plume area. Transect positions were located by survey triangulation.

During the course of the field work, it was found that the ambient water temperature varied from 1.5 to 3°C in 1-2 m of depth and that the variations were repeated in the water column. This data suggested multiple stratification in the rivers. At the present time, the authors have no explanation for this phenomenon. However, it raises a question concerning the validity of determining the ambient water temperature by single point measurement. In addition, one location in the St. Clair River was observed to have a temperature well below the temperature observed upstream. This suggested a large flow, subsurface discharge of ground water into the river.

419. National Field Investigation Center. 1970. Investigation of mercury in the St. Clair River--Lake Erie systems. National Field Investigation Center. Federal Water Quality Admin. Dept. of Interior. Washington, D. C. 115 p.

The toxic effects of mercury and its compounds in the water environment are well-known and are documented in the literature. Mercury is discharged to the water environment from industrial processes and uses of mercurial products. Mercury levels in sediments as well as in water are sampled and reported for the St. Clair River-Lake Erie system. Available information indicates that no measureable concentration of mercury was present in water supply intakes in the system. Mercury in excess of 1 mg/kg dry weight was present in sediments in the Erie, Pennsylvania and Euclid and Cleveland, Ohio areas and the Buffalo, Black, and Ashtabula rivers.
(UB)

420. National Oceanic and Atmospheric Administration. 1971. Annotated bibliography on fresh water ice. NOAA Tech. Memo. NOS LSCR 2. 425 p.

The bibliography lists over 2000 selected references pertaining to freshwater ice. A subject index and a geographic index make this body of information more accessible. The subject index divides the bibliography into engineering and research categories. Engineering entries constitute 30 percent of the total and include information on ice modification and control, engineering structures and technology, and navigation; scientific investigations on the formation, growth, and decay of freshwater ice constitute the research group. The geographic index is composed of approximately 47 percent of the abstracts. Of these, 13 percent identify studies in Antarctica, North America, and Greenland while 34 percent identify studies made in Europe and Asia. English language references account for approximately 34 percent of all abstracts. (UB)

421. National Planning Association. 1969. The role of Marine Science in the multiple uses of the coastal zone of Lake Erie and Lake Superior. Center for Techno-Economic Studies. National Planning Assoc. Washington, D. C. Unnumbered.

The National Council on Marine Resources and Engineering Development is developing a series of studies of the uses of the various types of coastal areas in the United States. The primary intent of these studies is to assess the effect which science and technology and institutional developments have had on the use of coastal zone resources and to determine the principles by which these measures may be strengthened to contribute even more to the effective utilization of capital, manpower, and natural resources in various coastal regions. For Lake Erie the study involves water quality and flood control.

422. Nebolsine, R., P. J. Harvey and C. Y. Fan. 1972. High rate filtration of combined sewer overflows. U.S. Federal Env. Protection Agency (EPA). Washington, D.C. Water Pollution Control Research Series. 11023 EYI 04/72. 339 p.

Pilot plant studies were conducted at Cleveland's southerly waste water treatment plant in 1970 and 1971 to develop and demonstrate the capabilities of the deep bed, dual media, high rate filtrate treatment process for storms causing combined sewer overflows. Principal advantages of the proposed system are: high treatment efficiencies, automated operation and limited space requirements as compared with alternate flotation or sedimentation systems. (UB)

423. Nebolsine, R., Pouschine, I., Fan, C. Y. 1973. Ultra high rate filtration of activated sludge plant effluent. Office of Res. and Monitoring. U.S. Env. Protection Agency. Washington, D. C. Env. Protection Tech. Series. EPA-R2 73-722. 114 p.

Pilot plant studies were conducted at the Southerly Wastewater Treatment Plant in Cleveland to evaluate the capabilities of the deep bed, dual media, ultra high rate filtration process for treating an activated sludge plant secondary effluent. The various operating variables that were tested and evaluated, included different media sizes, various depth, bed, filtration rates from 8 to 32 gpm/sq. ft., coagulants and polymer, and different combinations of coagulants and polymers. The principal parameter for evaluating process efficiency was suspended solids. High removals were obtained with respect to suspended solids and to pollutants associated with suspended solids. (UB)

Nelson, D. M. - See: J. G. Asbury, No. 71.

424. Nelson, E. W. 1956. Great Lakes Harbors. J. Waterways and Harbor Div. Proc. A.S.C.E. 83(WW3):7 p. Paper 1367.

Improvement in Great Lakes channels and harbors, which will be required as a result of projected completion of St. Lawrence Seaway. Works involved are deepening in the connecting channels as well as harbors, and breakwater reconstruction. (BECPL)

Nelson, R. T. - See: R. Stewart, No. 530.

425. Nelson, Goldberg & Heidt. 1959. Engineering study and report for preliminary planning of the development of Port of Erie for shallow draft vessels. Nelson, Goldberg & Heidt, Registered Engr. and Architects. Erie, Pa. 64 p.

This report is of preliminary scope and considers preliminary planning of engineering studies, surveys, subsurface investigations, soundings, layouts and the best estimates for proposed construction of harbor facilities consisting of docks, anchorages and essential shore installations related to the operation of recreational craft marina, commercial fishing craft and small boat services and repairs. (CE)

426. Nelson, Goldberg & Heidt. 1959. Report on preliminary planning Port of Erie. Nelson, Goldberg & Heidt. Registered Engr. and Architects. Erie, Pa. 11 p. + map.

This report covers only the reclamation and development of land and port, recreational and industrial uses, and it is not concerned with details for the final utilization of the reclaimed land. Two appendices are provided. Appendix A reports reclamation and development of land and port terminal and industrial uses. Appendix B reports additional harbor facilities to serve Lake boats and ocean vessels. (CE)

427. New York State Atomic and Space Development Authority. 1971. Nuclear power siting program, phase I, State-wide survey. New York State Atomic and Space Development Authority. 46 p.

This report completes the State wide survey portion of the nuclear power siting program. One of the areas within which the most suitable sites exist is the shore of Lake Erie and the Niagara River within New York State except for the Buffalo Niagara Falls area. In total there are eight recommended areas in the State.

428. New York State Dept. of Health. 1959. Efficiency of various methods of treatment, milk plant wastes, New York State. New York State Water Pollution Control Board. Dept. of Health, New York. Res. Rept. #2. pp. 78-102.

The Borden Food Products Company plant for making powdered milk is located in Arcade, New York. The milk waste treatment plant is directly behind the manufacturing plant. Treated waste are discharged directly to Cattaraugus Creek. The waste treatment plant includes primary and secondary settling with a recirculating trickling filter as part of the treatment.

429. New York State Dept. of Health. 1963. Lake Erie and tributary drainage basins in Chautauqua county (except Cattaraugus Creek and Silver Creek Drainage Basins). N. Y. State Dept. of Health. New York. Lake Erie-Niagara River Drainage Basins series. Rept. #6. 116 p.

This is a report on the survey of the surface waters of the west end of Lake Erie and of the designated tributary streams. It discusses the drainage and meteorological conditions and other hydrological factors. Domestic, industrial and transportation uses of water are discussed along with sewage and industrial waste disposal in brief.

430. The New York State Water Resources Commission. 1969. Erie-Niagara Basin Comprehensive Water Resources Plan. Erie Niagara Basin Regional Water Resources Planning Board. New York State Cons. Albany, New York. 201 p.

This report presents a comprehensive plan for water resources management and development in the Erie-Niagara Basin. It summarizes investigations which identified available resources and needs and opportunities for development. Numerous alternatives have been evaluated. The report (1) formulates the alternatives available to meet the needs for municipal and industrial water supply, water quality management, irrigated agriculture, water-oriented recreation, fish and wildlife enhancement, flood plain management and other functions and (2) integrates these alternatives into a coordinated development program for the period, 1970 to 2020, with emphasis on the early action (1970-1980) phase of the program.

431. Noble, V. E. 1961. Measurement of horizontal diffusion in the Great Lakes. Univ. Mich. Great Lakes Res. Div. Collected Reprints. 1:350-360.

The results of measurements of the rate of dilution of the center of a dye patch are compared with the theoretical prediction of the diffusion, the Goldstein-Michelson, and the Joseph-Sendner equations. Comparison of the results of 24 experimental observations with the theoretical curves shows that the Joseph-Sendner equation provides the best prediction for the two-dimensional diffusion process with a diffusion velocity of approximately 1.0 cm/sec.

432. Noble, V. E. 1965. On the decay of wind-driven current. Univ. Mich. Great Lakes Res. Div. Collected Reprints. 1:805-815.

Calculations on the rate of decay of wind-driven currents have been carried out for a finite current depth in a rotating basin. With a sudden decrease of the wind (step function) the surface current vector rotates approximately 60° in three hours, and decreases in magnitude as an exponential series. The effects of variations in eddy viscosity, surface energy loss coefficient, and initial current structure are shown.

Comparison of the surface current characteristics for the cases of step-function and gradual decreases of the wind seems to explain large differences observed for the wind stress under the conditions of wind reversal and wind veering.

Oeming, L. F. - See: H. A. Black, No. 103.

433. Ohio Dept. of Health. 1967. A report on recommended water quality criteria for ashtabula River, Conneaut Creek, and Turkey Creek, including interstate waters Ohio-Pennsylvania. Ohio Department of Health. Columbus, Ohio. 28 p.

This report summarizes basic data and considerations relating to further improvement and management of quality conditions in the Ohio-Pennsylvania interstate streams which are tributary to Lake Erie. These streams are Turkey Creek, Conneaut Creek, and the Ashtabula River. (CE)

434. Ohio Dept. of Health. 1967. Report and recommendations on water quality for North Central Ohio tributaries of Lake Erie including intrastate waters of the Portage, Sandusky, Huron, Vermilion, and Black Rivers. Ohio Dept. of Health. Columbus, Ohio. 41 p.

This report sets forth pertinent information with respect to the water uses and quality of the North Central Ohio tributaries of Lake Erie. It is to be used as a basis for formally establishing water quality standards for these streams by the Ohio Water Pollution Control Board in accordance with Chapter 6111, Ohio Revised Code. The standards consist of (1) the water uses assigned to a stream or section thereof, (2) the water criteria for such uses, (3) the treatment requirement for various waste discharges, and (4) a time table for providing the required treatment facilities. (CE)

435. Ohio Dept. of Health. 1968. Report and recommendations on water quality for the Rocky, Cuyahoga, Chagrin, and Grand Rivers and their tributaries. Ohio Dept. of Health. Columbus, Ohio. 80 p.

This report sets forth pertinent information with respect to the water uses and quality for the Rocky, Cuyahoga, Chagrin, and Grand Rivers and their tributaries. It is to be used as a basis for formally establishing water quality standards for these streams by the Ohio Water Pollution Control Board. The standards consist of (1) the water uses assigned to a stream or section thereof, (2) the water criteria for such uses, (3) the treatment requirement for various waste discharges and (4) a time table for providing the required treatment facilities. (CE)

436. Ohio Dept. of Natural Resources. 1953. Lake Erie pollution survey - Final report. Ohio Dept. of Natural Resources. Div. of Water. Columbus, Ohio. 201 p.

The report on the Lake Erie pollution surveys as reported in this volume is in five chapters and an appendix. The hydrology of Lake Erie and its tributaries on pollution is first discussed. It is noted that because of the rise of lake levels, the effects of present pollution would be intolerable on tributary streams and degradation of Lake Erie would be much more severe. The principal purpose of the bacterial and sanitary analyses has been to determine where and to what extent the lake water is seriously affected by sewage pollution. 25 tributary streams are sampled and examined.

437. Ohio Dept. of Natural Resources. 1953. Lake Erie pollution survey-supplement. Ohio Dept. of Natural Resources. Columbus, Ohio. 125 p.

Investigations of the chemical and physical properties of the water as pollution indeces included the following: water discharge, water temperature, oxygen consumed, color, ph, specific conductance, silicarbonate, sulfate, chloride, fluoride, nitrite, dissolved solids, hardness, dissolved oxygen, cyanide, phenols and suspended sediment. In addition, some industrial waste samples were analyzed for various constituents. These tests were made to provide general information to the industrial waste problems.

438. Ohio EPA. 1972. Radiological monitoring report-surface and ground waters of Ohio, 1969, 1970, 1971, 1972. Ohio EPA Div. of Surveillance. Columbus, Ohio. 19 p.

In 1961, Ohio established a radiological monitoring program to measure radioactivity levels in surface and ground waters of the State in order to determine natural background levels and levels due to discharge from major nuclear facilities. 56 sampling stations were established. It is found that sources of radiation cause only a slight increase in total radioactivity in the surface and ground waters. Expanded monitoring will be needed as proposed nuclear power plants on Lake Erie and the Ohio River come on line.

439. Okubo, A. and J. S. Farlow. 1967. Analysis of some Great Lakes drogue studies. Internat. Assoc. Great Lakes Res. Proc. 10th Conf. on Great Lakes Res. pp. 299-308.

The Great Lakes-Illinois River Basins Project of the U.S. Federal Water Pollution Control Administration conducted six field studies of horizontal diffusion in the Great Lakes. In each experiment, 50 to 90 individually identifiable drogues (current-following devices) were released at each test depth and were located at a series of later times. Lagrangian characteristics of diffusion, for example the root-mean-square distances between a pair of drogues, were evaluated by computer techniques. It was found that the intensity of turbulence differs little between Lakes Michigan and Erie, a typical value being 0.3 cm/sec, and that an effective diffusivity ranges from 3×10^4 to 6×10^4 cm^2/sec. In Lake Erie, the rate of energy dissipation per unit mass at a depth of 20 feet is less, by an order of magnitude, than that at 5 feet; a typical (5 feet) value being 2×10^{-4} cm^2/sec^3. Computations of diffusion velocities according to the theories of Joseph-Sendner and Okubo-Pritchard show that the turbulent diffusion in the surface layer seems to be more intense in Lake Erie than in Lake Michigan. In general, the values of diffusion characteristics obtained in the drogue studies are consistent with those obtained by other methods, such as dye studies.

440. Olds, N. V. 1966. Great Lakes water levels: How many masters can they serve? Mich. Natural Resources Council #11 Ann. Conf. pp. 26-33.

Fluctuation in Great Lakes levels are governed by hydraulics, hydrology, meteorology, and other physical sciences, their resultant effects extend into the fields of economics and law. This report discussed the economic aspects of the levels of the Great Lakes and the legal problems arising from the levels of the Great Lakes.

441. O'Leary, L. B. 1966. Synoptic vector method for measuring water mass movements in western Lake Erie. Univ. Mich. Great Lakes Res. Div. Pub. 15:337-344.

During the summer of 1963, the synoptic vector method of determining movements of water masses was used in the Michigan area of Lake Erie. By means of a high speed survey boat, a series of dye drops were made at preselected stations. The dye movements were measured after a peiod of 15 to 20 minutes. This was repeated under a variety of wind conditions and water temperature. At each station, vertical temperature profiles were measured as an indicator of homogeneity of the water mass. The plotted results show reasonable consistency. It was concluded that this method is a useful tool for determining water mass movements are expected to prevail.

442. Olmstead, L. W., and G. A. Lynde. 1958. Feeder beaches and groins restore Presque Isle peninsula. Civil Eng. 42:172-175.

Several times since 1819, the date of the earliest reliable survey data, the narrow neck of Presque Isle Peninsula has been entirely breached, and open water over a half mile wide has separated the end of the peninsula from the mainland. This was the situation when a new project for restoration and improvement of the peninsula was undertaken. In view of the conditions, the plan adopted for improving the neck section of the peninsula was designed to do two things: first, to supplement the natural supply of sand by artificial means, second, to reduce the rate of future losses by the use of groins. (UB)

443. Ordon, C. J. 1965. Stage-fall-discharge relationship in connecting channels. Univ. Mich. Great Lakes Res. Div. Proc. 8th Conf. Great Lakes Res. Div. Pub. 13:342-348.

Power and pollution control problems have created a need for better flow formulas in the connecting channels of the Great Lakes. Current formulas based on stage, fall, and discharge fail to agree with measured flows by several percent in some instances. It may be possible to improve upon the current U.S. Lake Survey method of formulating flow based on measured parameters by adding new factors not now taken into consideration. These are as follows: 1) Temperature effect on current meter calibration. 2) Temperature effect on the constants in the flow equation. 3) Season effect due to growth and death cycle of weeds in the stream bed. 4) Consideration of the fact that the flow may be nonuniform. A theoretical temperature correction factor has been developed. A possible weed correction curve for one reach has been plotted. Evidence that practically all connecting channels are draw down curves is presented.

444. Ostendorf, R. G. and J. F. Byrd. 1969. Modern monitoring of a treated industrial effluent. J. Water Pollution Control Fed. Jan. pp. 89-98.

From a treated industrial effluent analyzed on an automatic, continuous, almost instantaneous basis are recorded total carbon (TC), which can be correlated to BOD; SS; and pH. This instant monitoring of the treated waste stream quickly indicates any malfunction resulting in excessive or "off quality" waste in the effluent. This timely information enables the operator to take quick remedial action to correct the condition.

445. Palmer, M. D. 1970. Some operational notes on a submersible self-contained water quality meter. Internat. Assoc. Great Lakes Res. Proc. 13th Conf. on Great Lakes Res. pp. 1015-1019.

The operation of two prototype water quality meters on the Great Lakes in depths of 7 m for four months is described. The stability and reliability of the meters was checked by laboratory calibrations and data reduction. With the exception of the turbidity sensor, the meters maintained a reasonable calibration. A vigilant field maintenance and inspection program coupled with a well-designed data system is required if valid water quality data is to be obtained.

446. Palmer, M. D. and J. B. Izatt. 1970. Lakeshore two-dimensional dispersion. Internat. Assoc. Great Lakes Res. Proc. 13th Conf. on Great Lakes Res. pp. 495-507.

Hourly two-dimensional dispersion characteristics are determined from recording current meter histories for the nearshore areas on Lakes Erie and Ontario. The current histories were obtained in areas within 4 km of shore and at water depths of 10 to 14 m during May to November, 1968. A Markov chain process was applied to hourly current readings. Three different formulations of the stochastic process were tested prior to the selection of the most reliable one. The results obtained in applying the developed technique compare favorably with results obtained from conventional dye injection and drogue studies.

447. Palmer, M. D. and Izatt, J. B. 1972. Lake movements with partial ice cover. Limn. and Oceanog. 17(3):403-409.

A recording current meter was operated under a winter ice sheet at Nanticoke, Lake Erie, in 11 m of water at a depth of 3 m from the bottom. Current magnitude and direction and water temperature were measured every 10 min. Current magnitudes up to 1 month after the ice sheet formed were similar to measurements made without ice; autovariance density spectra for this period showed energy concentrations at frequencies corresponding to the free oscillation modes of Lake Erie. Several months after the ice had been in place the measured currents were half as fast (3-9 cm/sec) and spectra during this period showed no energy concentrations at Lake Erie oscillation frequencies. (UB)

448. Papp, R. A. 1958. Water intakes in the Detroit River. J. Sanitary Eng. Div. Proc. A.S.C.E. 84(SA6):1855.

It will be many years before concurrent high demands and severe weather test the Wayne County intake to its fullest extent in regard to icing. Heating and other de-icing equipment is developing and improving with time and experience and with sufficient flexibility built into an intake to allow for the installation of such equipment; preventive measures can be taken to keep ahead of problems which are sure to grow as intake rates increase. (CE)

Parker, A. G. - See: E. L. Pucel, No. 467.

Parker, D. C. - See: A. M. Beeton, No. 90.

449. Parmenter, R. 1929. Hydrography of Lake Erie. In: Preliminary report on the cooperative survey of Lake Erie. Bull. Buffalo Society of Natural Sci. XIV(3):25-50.

Work was done on determining surface temperatures, distribution of surface temperature, and current circulation, to determine their importance as factors in the transportation and possible destruction of plankton, fish eggs, and fry.

450. Parsons, Brinckerhoff, Quade & Douglas, Inc. 1968. Port of Erie Waterfront Development Plan. Parsons, Brinckerhoff, Quade & Douglas, Inc. 111 John St. New York, NY 10038. 73 p.

This report presents the findings of an engineering study of the Port of Erie Waterfront and a broad economic evaluation, based on previous market studies conducted by others, of the City of Erie's future prospects in shipping, recreational and industrial activities. 8 specific recommendations are given. (CE)

451. Paskausky, D. F. and D. L. Murphy. 1973. Two-dimensional numerical predictation of wind surge in Lake Erie. Internat. Assoc. for Great Lakes Res. Proc. 16th Conf. on Great Lakes Res. pp. 808-817.

During a wind storm, Lake Erie is essentially barotropic due to mixing; therefore, the hydrodynamics of the lake can be represented by a prognostic two-dimensional barotropic mathematical model developed from the vertically integrated momentum and continuity equations. A time-dependent wind stress drives the lake and the model includes effects of bottom friction, bottom topography, lateral boundary configuration and lateral mixing. A vorticity equation developed from the momentum and continuity equations is used to predict the circulation. The divergence of the vector form of the momentum equations is used to obtain the water level fluctuation consistent with the continuity equation and with velocity fields predicted by the vorticity equation.

Twenty m/sec winds are uniform over the model, but from 8 points of the compass are applied for 1.5 days to show effects of the boundaries and bathymetry on the circulation and water level fluctuation. Point Pelee, Pelee Island and Long Point are removed to show that they segment the lake into three circulation and setup regimes. Finally, winds varying similarly to a tropical storm are applied twice in the model,

once with the present lake and once with fill to represent the proposed airport at Cleveland.

452. Patterson, T. M. and H. F. Lawhead. 1968. History and present status of regulation and regulation studies of water levels and flows on the Great Lakes. In: Proceedings of Great Lakes Water Resources Conference. June 24-26, 1968. Toronto, Canada. pp. 201-228.

The paper considers those quantitative and timing problems and conflicts which are associated with the growing use and multi-purpose uses of the water resources of the Great Lakes and connecting channels and which may be susceptible to composite improvement through artificial controls and regulation of the levels and outflows. It reviews the regulation studies of the past; the progress in the application of methods and plans with respect to Lake Superior and Lake Ontario and brings out the international nature of controlling the levels of the Great Lakes. It outlines the purposes of the study which the Governments of Canada and the United States have placed in the hands of the International Joint Commission in the Lake Levels Reference of 7 October 1964 and provides the background to the series of papers which follow it.

453. Paul, J. and J. Prahl. 1971. Experimental and numerical investigations of rectangular jet. Internat. Assoc. Great Lakes Res. Proc. 14th Conf. Great Lakes Res. pp. 607-617.

Experimental and numerical results are presented for a rectangular constant temperature jet, horizontally entering a basin of constant depth equal to the vertical extent of the jet. The experimental investigation is carried out on a 6 ft. x 20 ft. (1.83 m x 6.10 m) water table. Velocity profiles are measured by a conventional hot film constant temperature anemometer. The numerical investigation is based upon a vertical integration of the three-dimensional, time-dependent Navier-Stokes equations for an incompressible fluid. The final equations solved are essentially two-dimensional volume flux equations with parameters in the inertial and bottom friction terms. Results, both experimental and numerical, indicate that the effect of bottom friction is to introduce a diffusive behavior to the jet.

454. Paul, J. F. and W. J. Lick. 1973. A numerical model for a three dimensional variable density jet. Internat. Assoc. Great Lakes Res. Proc. 16th Conf. Great Lakes Res. pp. 818-830.

A numerical model for the time-dependent, three-dimensional, variable-density and variable-temperature flow of a rectangular jet horizontally entering a basin of semi-infinite extent has been developed. Steady-state results are presented comparing the heated, constant-temperature and cooled jet for conditions similar to that which would be typical for the Cuyahoga River entering Lake Erie in the late summer months. The results indicate the importance of the coupling of the energy and momentum equations for this particular problem. The variable-density term in the momentum equations causes the jet to spread near the surface or the bottom and this affects the convection of energy in the convection of energy in the fluid. For the constant-density jet, vertical velocities are relatively small. However, for the variable-density jet, the vertical velocities are relatively large and are important in the transport of mass, momentum and energy.

Peace, R. L. Jr. - See: R. A. Brown, No. 117.

Peace, R. L. Jr. - See: G. E. McVehil, No. 404.

Pentland, R. L. - See: E. Megerian, No. 406.

455. Pentland, R. L. 1968. Runoff characteristics in the Great Lakes basin. Internat. Assoc. Great Lakes Res. Proc. 11th Conf. on Great Lakes Res. pp. 326-359.

Maps showing the distribution of runoff are presented for the entire Great Lakes Basin on a monthly and annual basis. Computerized methods have made possible the utilization of more than 250 hydrometric stations within and surrounding the basin for each of the 13 runoff maps. A graphical representation of the area-runoff distribution for the subbasins is also presented. The paper includes a general discussion of the effects of climatological and physical features in relation to the runoff characteristics.

456. Peters, R. W. 1962. A case study in problems and program Maumee Watershed Conservancy District. In: The Ohio State University Natural Resources Seminars--Developing effective water management systems to meet increasing demand. 1961-1962. pp. 116-129.

The Maumee Watershed Conservancy District includes the Ohio portion of the Maumee River basin. The purposes provide the district four major objectives: drainage, flood prevention, water supply and pollution abatement, erosion control and recreation. A water management plan is presented.

Phillips, D. L. - See: I. K. Abu-Shumays, No. 1.

457. Pincus, H. J. 1959. Types features of the Ohio shoreline of Lake Erie. J. of Waterways and Harbors Div. Proc. A.S.C.E. Proc. Paper 2297. 85(WW4):1-27.

Using aerial photographs for illustration, features of the Ohio section of Lake Erie's shoreline are examined in the following major categories: I--Elongated, sandy bodies of low relief; II--Lowland areas; III--Mouths of streams; IV--Bluffs; V--Artificial shorelines. Associated beach types are tabulated. The orientation of incident wave energy is correlated with some types of shore features. (CE)

458. Pincus, H. J. 1961. Engineering geology of the Ohio shore line of Lake Erie. Ohio Dept. Nat. Resources. Div. Shore Erosion. Columbus, Ohio. Tech. Rept. No. 7. 7 sheets(A-G).

A series of sheets presenting a compilation of data on the engineering geology of the Ohio shoreline of Lake Erie. The data have been organized with the aim of serving the engineer, the geologist, and others with a technical interest in this shoreline. The data are based upon over nine years of field, laboratory, and office study by personnel of the Ohio Division of Shore Erosion, and upon many published sources, particularly the Congressional reports of the U.S. Army Corps of Eng. Division personnel have mapped the entire Ohio shoreline of Lake Erie, using techniques ranging from reconnaissance methods in some areas to precise mapping on a scale of 1 inch to 50 feet in others. (CE)

459. Pincus, H. J. 1964. Retreat of lakeshore bluffs. J. of the Waterways and Harbors Div. Proc. A.S.C.E. Paper 3809. 90(WW1):115-134.

A qualitative, descriptive approach to the analysis of retreat of lakeshore bluffs indicates that a large number of factors are significant. Wave action, surface runoff, ground water seepage, ice and frost action, and slumping appear to be among the more important factors. Quantitative data on soil and rock properties, only sparsely available as yet, do not provide important new insights. However, the data are consistent with the behavior of corresponding materials in lakeshore bluffs. Additional quantitative data and new techniques are needed. Efforts of factors, such as degree of cementation, must be quantified. (BECPL)

460. Platzman, G. W. 1965. The daily variation of wind set-up on Lake Erie. Univ. Mich. Great Lakes Res. Div. Proc. 8th Conf. Great Lakes Res. Div. Pub. 13:273-277.

The daily variation of lake level is computed from six months of hourly data at each of several gage locations on Lake Erie. The results show a distinct diurnal constituent of longitudinal oscillation of the Lake as a whole, with Buffalo high water and Toledo low water at or shortly after noon. The amplitude of this oscillation is about 0.05 ft. A similar analysis is made of the daily variation of the surface wind vector at each of several anemometer locations on the periphery of the Lake. These results show a distinct diurnal constituent of the longitudinal component of the wind-square vector, with maximum in the direction Toledo to Buffalo at about one hour after noon. The amplitude of this variation is about 50 $mi^2\ hr^{-2}$. All evidence is consistent with the hypothesis that the diurnal constituent of lake level is caused by a diurnal constituent of wind stress. On the other hand, the semidiurnal constituents of lake level are caused mainly by astronomical tides.

461. Platzman, G. W. 1966. Daily variation of water level on Lake Erie. J. Geophys. Res. 71(10):2471-83.

Investigation was made to determine to what extent variation can be accounted for by corresponding daily variation of wind stress; estimates were obtained for diurnal and semidiurnal constituents of water level and of disturbing forces (wind stress, atmospheric pressure-gradient force, and gravitational tidal force); 6-mo series of 183 days was selected for data analysis.

462. Platzman, G. W. and D. B. Rao. 1964. Spectra of Lake Erie water levels. J. Geophys. Res. 69: 2525-2535.

Variance and covariance spectra of Lake Erie hourly scaled water levels are analyzed with resolution 0.1 cycle per day (in some instance 0.05 cpd) in the frequency range 0 to 8 cpd for thirteen stations in the 6-month 'summer' period April through September, 1958, and for some of these stations in the 6-month 'winter' period October, 1958, through March, 1959. The main contribution to variance spectra at most stations is in the range 0 to 1 cpd. Inherent noise levels are between 10^{-4} and 10^{-3} ft^2/cpt; scaling noise is at most about 10^{-4} ft^2/cpd. The most conspicuous features of summer variance spectra are strong and consistent peaks near periods of 14.1 hr., 9.2 hr., 6.0 hr., and 4.1 hr., which correspond to the first four modes of longitudinal free oscillation of the lake. A diurnal peak appears consistently in analysis with 0.1-cpd resolution; with 0.05-cpd resolution a distinct semidiurnal peak emerges at 12.3 hr. Covariance spectra give phases consistent with the hypothesis that the fundamental mode of oscillation is an amphidromic Kelvin-type wave, in which there is counterclockwise rotation of the phase of high water. (UB)

Plude, G. H. - See: F. E. Krauss, No. 351.

463. Policastro, A. J. 1972. State-of-the-art of analytical modeling of heated effluent dispersion in large lakes. Internat. Assoc. Great Lakes Res. Proc. 15th Conf. Great Lakes Res. pp. 642-654.

This state-of-the-art paper identifies and contrasts available mathematical models for predicting heated effluent dispersion from surface discharges into large lakes.

The basic approaches in the mathematical modeling of the jet, far-field, and complete-field regions are reviewed. Four jet regime models, nine far-field models and three complete-field models are summarized as to major characteristics. The jet models are compared as to the method of analytical approach, dimensionality, ambient cross flow, wind stress considerations, buoyancy, ambient stratification, surface heat loss, shoreline and bottom effects, discharge position and configuration, flow establishment considerations availability of computer routines and whether the models have been applied to field or laboratory data or both.

Basically, the same issues are discussed in relation to the far-field models and the group of models that consider the whole flow field.

The review indicates that in some instances there are significant differences in modeling approaches. Since these differences basically arise in assumptive or intuitive parameterizations, it is imperative that these models be tested against prototype field data to establish their validity. A program is in progress to compare these models with actual field data.

Polytech, Inc. - See: Euthenics, Inc., No. 228.

464. Portman, D. J. 1960. An improved technique for measuring wind and temperature profiles over water and some results obtained for light winds. Univ. Mich. Great Lakes Res. Div. Collected Reprints. 1:319-326.

An improved experimental arrangement for accurate measurement of wind profiles over deep water was devised and tested. The technique and the instruments used appeared to obviate some of the important difficulties commonly encountered. The drag coefficients computed from equilibrium profiles in nearly adiabatic conditions support the idea that the drag coefficient increases with increasing wind speed. Profiles measured in transient conditions are likely to deviate significantly from the logarithmic relationship and, therefore, cannot be used to compute shear stresses and drag coefficients.

Poston, H. W. - See: W. W. Aultman, No. 72.

Pouschine, I. - See: R. Nebolsine, No. 423.

465. Powers, C. F., D. L. Jones, P. C. Mundinger and J. C. Ayers. 1960. Applications of data collected along shore to conditions in Lake Erie. Univ. Mich. Great Lakes Res. Div. Great Lakes Res. Div. Pub. 5:78 p.

The results and techniques presented in this report have come from the Lake Erie pilot study on the usefulness of the data being accumulated by municipal and industrial users of lake water. They show that these data have a potential in understanding past events in the lake and in "watching" the lake for the development of trends in the

future.

The pilot study and the studies of past aquatic conditions that have accompanied it have made available a substantial amount of new information and techniques which may help explain the causes of past fluctuations in the commercial fisheries and contribute to our understanding of the more academic problem of eutrophication of lakes.

There are still a number of facets of the past conditions of the aquatic environment that have yet to be studied. Among these may be mentioned the assembly of a record of past unusually severe or unusually mild meteorological conditions and their probable effects on the lake, further search for biological indications of changing or changed conditions in the water, and the development of a set of criteria by which the data from representative water-user installations can be watched for the development of trends favorable or unfavorable for commercially important fish species.

Prahl, J. - See: J. Paul, No. 453.

Prahl, J. - See: A. Strazisar, No. 531.

Prastein, S. M. - See: I. K. Abu-Shumays, No. 1.

466. Pratt, R. W. 1913. Sewage disposal investigations at Cleveland. Eng. News. 69(7):287-294.

A series of tests are being made for the preparatory to the design of sewage treatment works in Cleveland, Ohio. Various methods of treating the sewage are discussed. Tests made before building the proposed works are outlined and the testing station is described. The station includes grit chamber screens and tanks for preliminary treatment; rapid filters or scrubbers; sprinkling filter; auxiliary settling tanks and a disinfection plant for final treatment; sludge digestion tank and sludge-drying beds. (BL)

Prepejchal, W. - See: J. G. Asbury, No. 71.

467. Pucel, E. L., E. J. Kovacic, F. H. Durkin, T. F. McCafferty and A. G. Parker. 1946. Stream pollution to the council of the City of Cleveland, Ohio. City of Cleveland. Legislative Department. Cleveland, Ohio. 43 p.

This report presents the problem of stream and lake pollution by sewage and industry in the city of Cleveland.

468. Puleo, J., M. C. Lanighan and C. O. Masters. 1974. 1973 Erie County stream survey. Public Health Div. Erie County Lab. Buffalo, New York. 294 p.

The overall concept of the 1973 stream survey was an attempt to determine just how "bad was bad" in terms of the water quality of Erie County's streams. It was decided to study and sample downstream areas proximal to reasonable degrees of urbanization, suburbanization or industrialization. These would be the areas that would most likely be sources of polluting discharges. It was determined that the general overall stream quality of Erie County streams has not improved. It appears very strongly that the basic problem which affects the quality of water in Erie County streams is in reality the failure of sewage treatment plants to adequately treat sewage. For industrial pollution, it was found that the natural buffering capacity of moderately hard waters seemed to absorb most of the industrial pollutants. 15 streams in the Erie County were sampled.

Quigley, R. M. - See: P. J. Gelinas, No. 262.

469. Quigley, R. M. and D. B. Tutt. 1968. Stability--Lake Erie north shore bluffs. Internat. Assoc. Great Lakes Res. Proc. 11th Conf. Great Lakes Res. pp. 230-238.

The 145-foot high bluffs along the north shore of Lake Erie are retreating about 5 feet per year through a combination of large circular arc toe failures and toe erosion by wave action. Drained direct shear tests run on the clayey silt till, which comprises the bulk of the slopes, yielded peak cohesion intercepts of 280 to 700 pounds/square foot and peak friction angles of 26 to 28 degrees. A much reduced residual cohesion intercept of 100 pounds/square foot was obtained on all samples whereas the residual friction angles were about the same as the peak values. Stability calculations, assuming a horizontal flow pattern, and field observations showed that toe circles are more critical than deeper failures; however, the latter in certain situations could also fail.

470. Quinn, F. H. 1964. Stage-fall discharge equations for the connecting channels of the Great Lakes. Univ. Mich. Great Lakes Res. Div. Proc. 7th Conf. Great Lakes Res. Div. Pub. 11:267-282.

Stage-fall discharge equations of the Great Lakes connecting channels are important tools in analyzing hydraulic and hydrologic phenomena. The uses of these equations include the determination of flows, the computation of effects of channel regimen changes, and the determination of water surface profiles in the connecting channels. The flows computed by the equations are used for regulation plan inflows, evaporation studies, and stream pollution studies.

Many uses of the equations require results as precise as it is possible to obtain. For example, the degree of lowering of the Great Lakes due to channel changes is required to within ± 0.05 ft. Experience and examination of the hydraulic elements of the channels under consideration have shown that uniform flow discharge equations do not adequately describe the phenomenon of flow in the connecting channels. Thus, the development of a non-uniform flow stage-fall discharge equation is necessary.

471. Quinn, F. H. 1971. Quantitative dynamic mathematical models for Great Lakes research. Dissertation Abstracts International, Section B. Paper 32233. University Microfilm, Ann Arbor, Mich. (Dissertation Order No. 71-23, 852, 141 p.) 32(3): 1591-B.

The dynamic mathematical models are presented for use in Great Lakes Research studies. The hydrologic response model is a water quantity model encompassing Lakes Michigan, Huron, St. Clair, and Erie and their connecting channels. The input parameters include over-water precipitation, tributary runoff, evaporation and diversion rates for each lake in the system and ice retardation rates and discharge equations for the connecting channels. The model outputs are mean water levels for each lake and flow rates in the connecting channels. (UB)

472. Quinn, F. H. 1973. Effects of ice retardation on Great Lakes water level. Internat. Assoc. Great Lakes Res. Proc. 16th Conf. Great Lakes Res. pp. 549-555.

Ice retardation in the connecting channels is one of the important mechanisms in the natural regulation of the Great Lakes System. It reduces the winter flows in the connecting channels, thus storing additional water on the lakes for release during the remainder of the year. It is

also an important factor to consider when evaluating the impact on lake levels of such activities as winter navigation and thermal discharges in connecting channels. The analysis of the effects of ice retardation on water levels was accomplished using a hydrologic response model of the Great Lakes system with ice retardation rates as variable input parameters. A base period of 1950-1966 was selected to define the ice retardation rates in the St. Clair, Detroit, and Niagara Rivers. These retardation rates were then varied and their system effects determined by the model. Historical perspective was obtained by comparing ice retardation rates during the early 1900's with those of the base period. The results of the study show that ice retardation in the Detroit and Niagara Rivers has little effect upon the water levels of the system. However, a reduction in ice retardation since the early 1920's in the St. Clair River has resulted in an average increase in lake levels at the end of December ranging from -10 cm for Lake Michigan-Huron and -6 cm for Lake Erie. The seasonal cycle for each of the lakes was also modified. Design curves were developed and are included for use in estimating effects of future changes in ice retardation upon the water levels of the Great Lakes.

473. Quinn, F. H. and E. B. Wylie. 1972. Transient analysis of the Detroit River by the implicit method. Water Resources Res. 8(6):1461-1469.

A hydraulic transient model of the Detroit River is developed by using the implicit method to solve the complete equations of continuity and motion. The river is modeled in the shape of a Y and has one main channel and two branching channels. The stability of the numerical solution, which uses the Newton-Raphson algorithm, is found to be dependent on the selection of a weighting coefficient. This coefficient determines the position at which the equations are evaluated on the X-t grid. The model inputs consist of water surface hydrographs at the head and mouth of the river. The outputs consist of flows at each end of the three channels and water surface elevations at the junction of the Y. Transient flows of the Detroit River induced by a severe wind tide on Lake Erie were stimulated to illustrate the model. Good agreement was obtained between measured and computed water surface elevations at the junction of the Y. (BECPL)

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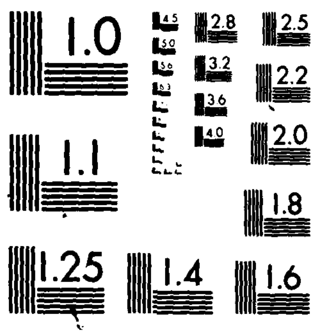

MICROCOPY RESOLUTION TEST CHART

NATIONAL BUREAU OF STANDARDS 1963-A

474. Rainey, R. H. 1967. Natural displacement of pollution from the Great Lakes. Science. 155(3767): 1242-1243.

A simplified mathematical model of a lake system indicates that, if the pollution of the Great Lakes were discontinued, the natural flow through the lower Great Lakes would be sufficient to remove about 90 percent of the waste in about 20 years. On the other hand, hundreds of years would be required to displace the pollution from Lake Michigan and Lake Superior.

Rao, D. B. - See: T. S. Murty, No. 417.

Rao, D. B. - See: G. W. Platzman, No. 462.

475. Rayner, A. C. and R. L. Rector. 1961. Groins on the Great Lakes. J. of Waterways and Harbor Div. Proc. A.S.C.E. 87(WW4):137.

Discussion is given on the paper--Groins on the shores of the Great Lakes, by C. E. Lee, Proc. paper 2819. The principal benefit of shore structures, cost and effectiveness of groins in the Great Lakes area are discussed. (CE)

Rector, R. L. - See: A. C. Rayner, No. 475.

476. Regional Planning Commission. 1961. Lakefront study--fourth report, water pollution. Regional Planning Commission. Cuyahoga County. Cleveland, Ohio. 54 p. + map + chart.

This fourth report deals with the problems of water pollution in Cuyahoga County. The objective is to identify the elements of pollution, to evaluate them in relation to waterfront activities and to indicate the present status and future prospects of pollution control. Although methods of control are essentially business of engineers, water pollution cannot be ignored in discussing the other physical planning aspects of the lakefront. This report lists and analyzes both the municipal and the industrial problems of water pollution control. A section containing a summary and findings follows the introduction. Material for the report came from local, state and federal sources and several other large cities. (CE)

477. Regional Planning Commission. 1962. Lakefront study, summary. Regional Planning Commission. Cuyahoga County. Cleveland, Ohio. 108 p.

This study records existing facilities, future needs and possible physical solutions of some of the major problems of the Cleveland lakefront. Suggestions are made for immediate programs and long-range developments. Plans covering both immediate programs and long-range goals suggest that a program of future development must have both approaches initiated with the main concerns of water pollution and shore erosion in the area. (CE)

478. Reitze, A. W. Jr. 1968. Waste water and wishful thinking: The battle of Lake Erie. Case Western Law Review. 20(1):5-85.

Lake Erie, as with most polluted bodies of water, is not subjected to a homogeneous input of deleterious pollutants. Rather, the Lake is the recipient of a variety of pollutants. This report reviews all pollutants in the Lake Erie and their sources. The management as well as some recommendations to this pollution problem discussed.

Remus, G. J. - See: W. W. Aultman, No. 72.

479. Remus, G. J. 1969. Detroit's metropolitan water pollution control program in action. National Academy of Eng. Symposium. 5th Autumn Meeting. Paper 03076. pp. 91-96.

A program for controlling water pollution is described. Eleven recommendations for organizing the prevention of water pollution in metropolitan towns are listed. Cost considerations are also present. (UB)

480. Remus, G. J. 1970. Storm water retention can work and prevent the heavily polluted first flush from overflowing to damage the receiving river. Am. City. 85(10):68-69.

Retention of the major portion of the May 25 storm in Detroit's combined sewers thus reducing pollution of Detroit and Rouge rivers was one of the first dramatic demonstrations of Detroit's new sewer monitoring and remote control system. The monitoring equipment are introduced briefly. (UB)

481. Richards, T. L. 1963. Meteorological factors affecting the ice cover on the Great Lakes. Univ. Mich. Great Lakes Res. Div. Proc. 6th Conf. Great Lakes Res. Div. Pub. 10:204-215.

From a study of two lakes of different characteristics, Erie (shallow) and Superior (deep), over the four years of aerial ice reconnaissance 1959-63; it is apparent that there is good correlation between ice cover and the accumulation of freezing and thawing degree days as recorded at a nearby meteorological station.

Freezing and thawing degree day data from a 14-year record were used to calculate averages and extremes, as shown by Figures 11 and 13. These data used in conjunction with Figures 10 and 12 then give an indication of average and extreme ice conditions that may be expected for each lake.

The number of thawing degree days accumulated during the preceding heating season is a factor in determining the date of first ice and the extent of ice cover during the winter. It appears consistent that the heat stored in the lake should be proportional to this antecedent heating.

The depth of the lake has a direct effect on the formation, retention and dissipation of ice cover, no doubt because the heat storage capacity of the water mass is proportional to the depth.

Winds strong enough to produce waves and thus mixing in the water are a deterrent to the growth of ice cover, and in the case of a deeper lake will actually reduce ice cover.

Reduction of ice cover is a much more rapid process than the formation of ice and requires a much smaller change in temperature. In this connection, it has been noted that the thawing process in the late winter and early spring is aided by increased incoming radiation, a change in albedo of the snow and ice, and the latent heat of condensation.

The graphs in Figures 10, 11, 12, and 13 provide a graphical method of forecasting ice covers on Lakes Erie and Superior from a long range forecast of mean temperatures. This forecast of mean temperatures. This forecast may be improved subjectively by considering the antecedent heating.

To strengthen the predictive value of the study, a statistical

method was developed for forecasting ice cover based on the antecedent heating and the accumulation of freezing degree days. This took the form of a regression equation:

$$Y = b_0 + b_1X_1 + b_2X_2$$

where Y = ice cover (%)

X_1 = accumulation of freezing degree days

X_2 = antecedent heating

For Lake Erie, the equation becomes:

Ice cover (%)= $227.5 + .118\ X_1 - .0364\ X_2$

482. Richards, T. L. and J. G. Irbe. 1969. Estimate of monthly evaporation losses from the Great Lakes, 1950-1968, based on the mass transfer technique. Internat. Assoc. Great Lakes Res. Proc. 12th Conf. Great Lakes Res. pp. 469-487.

The Meteorological Service of Canada is currently making estimates, at the end of each month, of the monthly evaporation losses from each of the Great Lakes bordering on Canada. These estimates are based on the mass transfer technique using modified wind and vapor pressure data from shoreline climatological stations and surface water temperature data from regular airborne radiation thermometer flights and ships' surveys. This paper presents a brief review of the technique and provides a record of monthly evaporation losses from each of the Lakes over a relatively long period.

483. Riché, C. S. 1926. The St. Lawrence Waterway to the sea. Proc. A.S.C.E.--Discussions. 52:87.

Discussion of the opening of the Great Lakes to ocean traffic. (UB)

484. Ridenour, G. M. 1938. Grit chamber model tests for Detroit, Michigan, sewage treatment project--Discussion. Proc. A.S.C.E. 64(3):632-634; 64(4):847-56; 64(7):1529-1930.

A discussion made on the paper, "Grit chamber model tests for a Detroit, Michigan, sewage treatment project" by G. E. Hubbell. (BL)

485. Risley, C. Jr. and W. L. Abbott. 1966. Radioactivity in Lake Erie and its tributaries. Univ. Mich. Great Lakes Res. Div. Proc. 9th Conf. Great Lakes Res. Div. Pub. 15:416-422.

Gross alpha and gross beta radioactivity levels of water, bottom sediment, and plankton samples in Lake Erie and in the tributary mouths were determined in a study conducted by the U.S. Public Health Service from 1963 to 1965. Values for dissolved solids and bottom sediment beta activities in the lake were generally quite low with ranges of less than one to 39 picocuries per liter and 11 to 81 picocuries per gram, respectively. Plankton beta activity results ranged from 33 to 1200 picocuries per gram, indicating the ability of these organisms to concentrate radionuclides. The tributary alpha and beta radioactivity values were low with slightly higher activities evident during the spring season, which may only be reflecting increased precipitation and runoff. Lake Michigan average radioactivity results, by comparison, differed little from Lake Erie values; but the individual activities exhibited greater ranges, and higher results tended to cluster around the northern part of the lake, especially in Green Bay.

486. Ritchie, G. A. and J. N. Speakman. 1973. Effects of settling time on quality of supernatant from upland dredge disposal facilities. Internat. Assoc. Great Lakes Res. Proc. 16th Conf. on Great Lakes Res. pp. 321-328.

Investigations into the quality of sediments dredged from Ashtabula and Fairport Harbors, Ohio, and the effect of settling on quality of the supernatant were conducted for the Buffalo District, Corps of Engineers.

Settling times of 1-40 hr. produced 95-99% reductions in the concentrations of most pollutants tested. Total phosphorus and Kjeldahl nitrogen were reduced from 10 and 700 mg/l, respectively, to less than 1 and 75 mg/l after one hour. Heavy metals, present in concentrations up to 260 mg/l, were reduced to below 0.3 mg/l after one hour and 0.1 mg/l after 40 hr.

Calculations indicate that use of confined disposal facilities at Ashtabula and Fairport Harbors would reduce pollutant loading to Lake Erie from dredging by more than 95% for most contaminants.

Robeck, G. G. - See: K. A. Dostal, No. 204.

487. Robertson, Andrew. 1969. What is happening to our Great Lakes. Limnos. 2(1):12-17.

Lake Erie is aging noticeably due to a great increase in nutrient concentrations. In the western end of Lake Erie, the changes have been especially noticeable because of the proximity of Detroit and because the western part of Lake Erie is very shallow. The volume of Lake Erie is relatively small compared to the outflow rate, and if pollution were stopped today, it would only take 6 years for 90 percent of the dissolved nutrients to be flushed into Lake Ontario.

488. Rockwell, D. C. 1966. Theoretical free oscillation of the Great Lakes. Univ. Mich. Great Lakes Res. Div. Proc. 9th Conf. Great Lakes Div. Pub. 15: 352-368.

The lowest five modes of longitudinal free oscillation of each of the Great Lakes are investigated by numerical integration of the hydrodynamical channel equations. The corresponding periods, surface profiles, and volume transports are presented and discussed. The fundamental periods are: Lake Superior, 7.2 hr.; Lakes Michigan-Huron, 47.8 hr.; Lake Michigan, 8.8 hr.; Lake Huron, 6.5 hr.; Lake Erie, 14.1 hr.; and Lake Ontario, 4.9 hr. Special consideration is given to Lakes Michigan and Huron in connecting these lakes through the Straits of Mackinac.

Rodgers, G. K. - See: D. V. Anderson, No. 8.

Rodgers, G. K. - See: J. P. Bruce, No. 121.

Rodgers, G. K. - See: J. R. Kramer, No. 350.

489. Rodgers, G. K. 1965. The thermal bar in the Laurentian Great Lakes. Univ. Mich. Great Lakes Res. Div. Proc. 8th Conf. Great Lakes Res. Pub. 13: 358-363.

Recent spring surveys in the Great Lakes have provided information about the large horizontal temperature gradients which occur in that season. Current measurements, detailed temperature profiles, water analyses and heat content changes all suggest that a "thermal bar," the mixing zone between waters less than 4°C and waters greater than 4°C, constitutes

a barrier to extensive offshore movement of the warmer water near the shore. Sinking of 4°C water in the thermal bar appears to imply upwelling in the central cold zone, and enhancement of the thermocline forming in the warmer nearshore zone. The existence of this thermal barrier can affect diffusion of runoff and pollutants introduced near the shore, particularly during its first occurrence, close to shore early in spring.

490. Rodgers, G. K. 1972. Great Lakes Institute, data catalogue and methods for 1960 to 1970. Institute of Env. Sci. and Eng. Univ. Toronto. Pub. EG-7. 306 p.

This publication provides a systematic inventory of data collected in various programs carried out with the facilities made available by or through the Great Lakes Institute, University of Toronto. This report is to document the methods used in the collection and recording of data. It has not been possible to track down the desired detail of some of these, as a variety of researchers have come to the program with their own particular techniques. In many cases it will be necessary for the interested person to contact the principal investigator for exact details. (CE)

Romberg, G. P. - See: J. G. Asbury, No. 71.

491. Rondy, D. R. 1966. Great Lakes ice cover, winter, 1965-1966. Corps of Engineers. Lake Survey Div. Detroit, Mich. Basic data rept. 5-2. 44 p.

This report describes the U.S. Lake Survey's 1965-66 aerial ice reconnaissance program and presents 22 ice reconnaissance flights. A brief description of ice conditions on each of the Great Lakes and a summary of weather conditions is included.

492. Rondy, D. R. 1969. Great Lakes ice cover, winter, 1962-63 and 1963-64. Corps of Engineers. Lake Survey Div. Basic Data Rept. 5-5. 47 p.

This report describes the U.S. Lake Survey's 1962-63 and 1963-64 aerial ice reconnaissance program and presents 31 ice charts produced from 21 ice reconnaissance flights. A brief description of ice conditions on each of the Great Lakes and a summary of weather conditions are included. (CE)

493. Roosen, J. J. and R. C. Ball. 1971. Ecological effects of a thermal power plant on the aquatic habitat of a large fresh water lake in the United States. The 8th World Energy Conference. Bucharest, Romania. June 28-July 2, 1971. 19 p.

This paper describes the qualifying and quantifying of the chemistry and biology of the aquatic environment of the lake receiving discharges from the large generating plant. Included are the design basis and description of the ecological program that was formulated by Michigan State University to determine the impact of the plant on the aquatic habitat. The paper details information to be collected in the areas of: (1) basic plant producing groups--the periphyton, the phytoplankton and the macrophytes, (2) zooplankton, (3) bottom fauna, (4) fish, and (5) waterfowl. Physical and chemical studies are also described.

The significance of physical, chemical, and biological changes are discussed from the standpoint of minimizing detrimental ecological changes due to plant operation and conserving the large fresh water resource available for multi-purpose use.

Rosenberg, H. B. - See: A. M. Beeton, No. 91.

494. Rudolph, W. 1957. Sewage treatment for growing city. Pub. Works. 88(2):117-119.

The new system for Erie, Pa., will have capacity to carry expected flows from population in excess of 200,000. Flows to old plant averaged around 32 mgd is reported. Intermediate treatment was required to reduce pollution load on Lake. Old primary plant had to be enlarged and aeration for settled sewage. Sewage strength design, the basis of the new plant, is 150 ppm BOD. (UB)

495. Ruggles, A. V. 1920. Planning the future of the Cleveland's water supply. Eng. News-Record. 85(19):886-889.

A comprehensive plan for the future development of the water supply system of Cleveland, Ohio, has been made by the engineers of the Division of Water. The methods of investigation pursued, the results obtained and the conclusion reached are briefly discussed in this report. (BL)

Rukavina, N. A. - See: D. A. St. Jacques, No. 521.

496. Rukavina, N. A. and D. A. St. Jacques. 1971. Lake Erie nearshore sediments Fort Erie to Mohawk Point, Ontario. Internat. Assoc. Great Lakes Res. Proc. 14th Conf. Great Lakes Res. pp. 387-393.

Bottom samples, echo sounder records, and underwater television and diver observations have been used to map the geology and bathymetry of the nearshore zone of northeastern Lake Erie.

Nearshore materials consist of bedrock (25%), glacial drift (25%), and the recent sediments sand (35%) and silt-sand (15%). Bedrock is exposed in the inshore half of the zone. Glacial drift occurs inshore at the western end of the area and offshore in the central portion. Recent sediment is present on the submerged Port Maitland moraine, in the offshore half of the zone east of Point Abino, and as shallow-water bay deposits.

The sand on the moraine is a lag deposit produced by reworking of underlying glacial drift. The eastern deposit and the bay sediments result from accumulation of sediment transported by eastward-moving longshore currents. The minimum depth at which offshore sand occurs varies across the area from 10-18 m.

Rumer, R. R. - See: P. J. Buechi, No. 127.

Rumer, R. R. - See: J. A. Howell, No. 311.

497. Rumer, R. R. 1970. Dynamic model study of Lake Erie. Part I. Similitude criteria and experimental setup. Faculty of Eng. and Applied Sci. State Univ. of New York at Buffalo. Civil Eng. Rept. No. 18.1 41 p.

This is the first of a two-part report dealing with a hydraulic model study of Lake Erie. The first part considered the theoretical justification for the operation of a rotating vertically-distorted Froude model. It also described the experimental facilities designed and constructed for this study as well as the experimental procedures used in the acquisition of experimental data. (UB)

498. Rumer, R. R. Jr. 1970. Dynamic model study of Lake Erie. Part II. Analytical and experimental results. Faculty of Eng. and Applied Sci. State Univ. of New York at Buffalo. Civil Eng. Rept. No. 18.2. 38 p.

This is the second of a two-part report dealing with a hydraulic model study of Lake Erie. This second report considers the experimental results obtained and the relationship of these results to various mathematical model approaches. Prototype observations, where available, are also discussed. This second report ends by making recommendations for continued investigations in which a hydraulic model can be an important adjunct to the overall study of lake circulation and water quality management. (UB)

499. Rumer, R. R. and L. Robson. 1968. Circulation studies in a rotating model of Lake Erie. Internat. Assoc. Great Lakes Res. Proc. 11th Conf. Great Lakes Res. pp. 487-495.

Experimental results obtained from a rotating vertically distorted Froude model of Lake Erie are presented. The model has a horizontal length scale of 1:200,000 and a vertical scale of 1:500. The experiments were conducted in a completely enclosed rotating laboratory to simulate the effect of the earth's rotation. The laboratory is briefly described.

Data related to mass oscillation, residence time in the Lake, and circulation patterns are presented and discussed. These initial studies have been made for the idealized case of zero wind stress with the inflow of the Detroit River made equal to the outflow of the Niagara River.

Experience, thus far, has shown that the model can be operated and that reproducibility of results is good. The significance of the results and future studies are discussed.

500. Sanderson, M. E. 1966. The 1958-1963 water balance of the Lake Erie Basin. Univ. Mich. Great Lakes Res. Div. Great Lakes Res. Div. Pub. 15:274-282.

The study uses a climatic water balance method to determine monthly runoff at the 133 climatic stations in the Lake Erie basin, permitting the preparation of monthly maps of runoff. An isopleth mapping technique is used to estimate total

runoff. Monthly over-water precipitation is similarly estimated using data from perimeter stations. Monthly net lake evaporation is obtained as a remainder in the water balance when precipitation and runoff fail to meet the needs of lake evaporation and water is withdrawn from the Great Lakes system.

501. Sandoski, D. A. 1972. Selected urban runoff abstracts--July, 1971-June, 1972. Office of Research and Monitoring. U.S. Env. Protection Agency. Washington, D. C. 20460. Env. Protection Tech. Series. EPA-R2-72-127. 97 p.

The July, 1971-June, 1972, supplement to "Selected urban storm water runoff abstracts" is a compilation of abstracts summarizing articles from a variety of technical literature and from conferences both domestic and foreign, primarily related to the problems of urban runoff caused by storm water discharges, combined sewer overflows and non-sewered urban runoff. 215 abstracts have been made in this report. (UB)

502. Schenehen, F. C. 1926. The St. Lawrence Waterway to the sea. Proc. A.S.C.E.--Discussions. 52: 942-948.

In Schenehen's discussion are additional ideas and notes relating to the feasibility of having an inland waterway. (UB)

503. Schoonmaker, G. N. 1942. Toledo's new Lake Erie water supply. Civil Engr. (NY). 12(6):316-319.

Details of design and construction steps in development of the Lake Erie project to augment Toledo's water supply are reported. (UB)

504. Schwemler, F. J. 1948. Cleveland's new water intake. Water and Sewage Works. 95(7):265-266.

Additional water supply of 1,000,000 gpd brings total capacity to 415,000,000 gpd. The subaqueous section will consist of a reinforced concrete pipe, having an inside diameter of 10 ft., pipe sections of 24 ft. long, weighing 50 tons. Sections are loaded onto a scow floated into position and then lowered into an open cut excavation in lake bottom. (UB)

505. Seddon, J. A. 1898. Mathematical analysis of the influence of reservoirs on stream flow. Proc. A.S.C.E. 24(6):559-598.

A detailed derivation of mathematical analysis of the influence of reservoirs on stream flow is given. The Great Lakes are considered as a series of reservoirs connected by connecting channels. Oscillations of the lakes are predicted. (BL)

506. Seelye, T. E. 1915. Restrict stream channel responsible for Erie flood damage. Eng. Record. 72(7): 186-189.

The loss of thirty lives and $2,000,000 worth of property by floods following the severe storm at Erie, Pa. on August 3, was due to encroachments by building bridges and culverts upon the channel of Mill Creek, which passes through the city for 3 miles. The causes of this flood are examined critically. (BECPL)

507. Shenehon, F. C. 1920. Plan to regulate the Great Lakes level by the Niagara Dam. Eng. News-Record. 84(7):308-313.

Regulating the level of the Great Lakes by works at the head of the Niagara River is no new proposal. As long ago as 1895, the Board of Engineers on Deep Waterways made a suggestion, which never got beyond the record stage. Now, the project is once more brought forward by the Chicago Sanitary District, which proposes to build it in the Niagara River, near Buffalo. Regulating works which are unique for such a purpose in that the main channel closure is to be made by a dam in section, roughly of boat shape, which are to be floated out to place every spring and locked in place, and every winter loosened and towed back to storage. Thus, ice difficulties are to be avoided, and the summer level of the Great Lakes is maintained for proper ship draft, in spite of the depletion due to the power and drainage canals leading from the lakes.

508. Sheng, Y. P. and W. J. Lick. 1973. The wind-driven currents in a partially ice-covered lake. Internat. Assoc. Great Lakes Res. Proc. 16th Conf. Great Lakes Res. pp. 1001-1008.

The steady-state, wind-driven currents in a partially ice-covered lake have been calculated numerically. Welander's shallow lake model is directly applied in the ice-free portion of the lake. In the ice-covered portion, the ice cover causes the water velocity to be zero at the surface. With this boundary condition, the equations of motion can be integrated and a single equation for the integrated stream function is obtained. The equations for the integrated stream functions in the two portions of the lake are solved and solutions matched across the interface. Horizontal velocities as a function of depth and horizontal location are then obtained.

Solutions have been calculated for a rectangular, constant-depth lake for different wind stresses, different wind directions, and different amounts of ice coverage. Relatively large currents occur under the ice for particular wind directions and frictional depths.

Solutions have also been calculated for a realistic model of Lake Erie. Two limiting cases have been studied, (1) an ice-covered Eastern Basin and (2) an ice-covered Western Basin. The effects of the ice cover in these two cases are considerably different due to the large differences in depth in the two basins.

509. Shukla, S. S. and H. V. Leland. 1973. Heavy metals a review of lead. J. Water Pollution Control Fed. 45(6):1319-1331.

Greater than natural concentration of chromium, cadmium, mercury, nickel, lead, zinc and other heavy metals in air, soil and surface waters are well documented, particularly in the urban areas. Several recent reviews considered heavy metals that are potential pollution hazards. The lead toxicity and source of lead pollution are discussed intensively in this paper. (UB)

510. Simons, T. J. 1973. Development of three-dimensional numerical models of the Great Lakes. Inland Waters Directorate. Canada Centre for Inland Waters. Burlington, Ontario. Scientific Series No. 12. 26 p.

This report describes a generalized numerical model for computing the water levels and the three-dimensional circulation and temperature structure of the Great Lakes. The

mathematical-numerical framework is borrowed from numerical weather prediction, storm surge forecasting, and ocean circulation models. In view of the prominence of the boundary-value problem in the modeling of relatively shallow basins, emphasis is placed on the proper treatment of the bottom topography.

The model is based on the hydrostatic and the Boussinesq approximations and employs a quadratic relationship between temperature and density anomalies. The equations for the layered system are derived by vertical integration over layers and by defining new vertical velocity relative to the interfaces. Thereby the model allows for rigid horizontal levels, sloping permeable interfaces, moving material interfaces, or any combination of these.

The formulation of the finite-differencing scheme is based on considerations of the energy balance of the physical system, and accuracy and economy of numerical computations. The problems of grid dispersion and the treatment of lateral boundaries are investigated with the help of an exact solution obtained for the response of a lake to a time-dependent wind stress simulating the passage of an atmospheric front.

511. Simpson, G. D., L. W. Curtis and H. K. Merkle. 1968. The Cuyahoga River, Lake Rockwell to Lake Erie. In: Proc. of a Symposium Commemorating the dedication of Cunningham Hall. Kent State Univ. November 1, 1968. pp. 87-120.

The purpose of the study was: to determine present water quality, to describe the existing aquatic environment, to project future conditions, and to prepare a project plan for pollution abatement and water quality improvement. This paper comprises a brief summary of the report and contains a short discussion of the biological studies, the chemical and physical data and the development of the engineering project plan.

512. Simpson, G. D. and L. W. Curtis Jr. 1969. Present water quality in the Cuyahoga River. Chemical Eng. Progress Symposium Series. Paper 42929. 65(97):64-74.

A study of the water quality of the Cuyahoga River in Northeast Ohio was made. The purpose was to define the present water quality and to project future qualities by using alternative methods of treatment of wastewater and flow augmentation. Extensive basic data collection included the chemical, physical, and biological characteristics. A dissolved oxygen model was constructed, and alternative methods were investigated with respect to meeting the recommended water quality criteria. (UB)

513. Simpson, G. D. and C. Lamont. 1969. Treatment of combined sewer overflows and surface waters at Cleveland, Ohio. J. Water Pollution Control Fed. 41(2):151-168.

A study has been conducted of the feasibility of a large stabilization retention basin in the off-shore waters of Lake Erie as a method of treating combined sewer overflows, polluted surface waters and waste water treatment plant effluent prior to discharge into Lake Erie. The plan would include a shoreline collection system to convey flows to the basin. General description of this plan is reported. (UB)

514. Sly, P. G. 1971. Submersible operations in Georgian Bay and Lake Erie. Inland Water Branch. Dept. of Energy, Mines and Resources. Burlington, Ontario. Tech. Bull. 44. 36 p.

Research activities, undertaken by the Limnogeology section, have been conducted mostly from surface vessels, using standard scarping, coring and sensing equipment. Some detailed surveys and equipmental trials have been supported by scuba diving techniques. To answer complex environmental problems and to ascertain the suitability of various diving techniques as they related to Great Lake Research, submersible operations in Georgian Bay and Lake Erie were conducted. The study included detailed lighology and changes in the surface appearance of bottom sediments; charting of shoal areas for hydrographic and navigational purposes, etc.

515. Smith, H. A. 1968. Hydro-electric power development on the Great Lakes system. In: Proc. of Great Lakes Water Resources Conf. June 24-26, 1968. Toronto, Canada. pp. 49-88.

It is the purpose of this paper simply to:

1. Review briefly hydro-electric development on the Great Lakes System.

2. Summarize the important conflicts in water use and benefits that have arisen from such development.

3. Indicate some of the major possibilities for future Great Lakes hydro-electric development, noting, in a qualitative manner only, their probable effects upon other water uses and the consequences of available alternatives.

4. Draw conclusions as to the need for evaluating such possibilities.

516. Smith, H. D. 1968. Boom controls river ice. Electrical Light & Power. January, 1968. 46(1): 80-1.

Installation of a 2 mi. boom on Lake Erie, across the entrance to the Niagara River at Buffalo which proved effective as an ice control device, is a joint venture of the Hydro-Electric Power Commission of Ontario and the Power Authority of the State of New York; the boom has enabled adjoining utilities to maintain maximum power production, provided open water around the City of Buffalo intake, and reduced damage from ice and high water along the upper Niagara River. (UB)

517. Smith, R. H. and R. D. Conner. 1968. Potential benefits of the Great Lakes level and flow regulation. In: Proc. of Great Lakes Water Resources Conf. June 24-26, 1968. Toronto, Canada. pp. 229-247.

The authors comment upon the natural stability of the Great Lakes system and that over the years, many interests have grown to depend on this stability. They review the requirements of these interests, noting that the needs of the interests often conflict. They point out that the ideals of constant lake levels, desired by some interests, and constant outflows desired by other interests, are not practical.

The authors, drawing on their experience with Lake Ontario regulation, present examples to illustrate what regulation

of Lake Ontario has accomplished since it was implemented in 1960 and stress that regulation results have been optimized through the use of operational discretion.

518. Smith, S. H. 1962. Lake Erie or Lake Erie? The Izaak Walton Magazine. April. pp. 4-5.

Pollution problems in Lake Erie are critically reviewed. It is noted that when lakes are used for the disposal of industrial and human wastes, the aging process may be greatly accelerated. Never before, however, has such a dramatic process of premature aging been detected in a lake the size of Lake Erie.

519. Sowers, G. B. 1940. Something new in Bulkhead anchorages. Eng. News-Record. 125(11):99-100.

Design and construction of steel sheet pile bulkheads along some sections of the new channel of the Cuyahoga River in Cleveland are reported. It is anchored by pile A-frames where lack of space, or sliding ground made ordinary deadman anchorage impractical. The back or tension leg of the A-frame consists of a concrete bulb pile, which developed more than 100 tons pulling resistance during the test. (BL)

520. Spangler, M. B. 1969. The role of marine sciences in the multiple uses of the coastal zone of Lake Erie and Lake Superior. Center for Techno-Economic Studies. National Planning Association. Washington, D. C. PB 185 163. 301 p. + 9 Appendix.

Lake Superior and Lake Erie were selected for study to illustrate the contrast of problems and opportunities in utilizing the waters and shoreline resources of the Great Lakes system. The analysis has lead to the conclusion that the priority emphasis for action should be directed toward preservation of the essentially undeteriorated resources of Lake Superior, and to combatting the further deterioration and restoration of the quality of resources of Lake Erie. A major conclusion of this study is that Lake Erie, far from being a "dead Lake" is capable of a significant degree of restoration of environmental quality if the sources of pollution entering Lake Erie are brought under effective control.

521. St. Jacques, D. A. and N. A. Rukavina. 1973. Lake Erie nearshore sediments-Mohawk Point to Port Burwell, Ontario. Internat. Assoc. Great Lakes Res. Proc. 16th Conf. Great Lakes Res. pp. 454-467.

Echo soundings and bottom samples were used to map the bottom materials of the Lake Erie nearshore zone (0-20 m) from Mohawk Point to Port Burwell, Ontario. The following bottom types were identified and delineated: 1) bedrock (10%), 2) glacial drift (50%) and 3) unconsolidated sediment (40%). Bedrock is exposed inshore between Mohawk Point and Port Dover. Glacial material occupies the offshore portion of the same area and a broad offshore shelf southwest of Long Point. The unconsolidated sediments were found along the crests of the Port Maitland and Long Point-Erie moraines, in Long Point Bay, inshore from Long Point to Port Burwell and offshore south of Port Burwell.

The shoreline adjacent to the study area is comprised of: 1) bedrock between Port Maitland and Peacock Point, 2) beach, dunes and marsh along Turkey and Long Points and 3) clay and sand-clay bluffs in Mohawk Bay, between Peacock and Turkey Points and from the base of Long Point to Port Burwell. The erosion of bluffs within the study area provides approximately 1,500,000 m^3 of sediment to the nearshore zone annually.

The prevailing southwesterly winds generate eastward littoral currents that transport sediment derived mainly from shoreline erosion from west to east across the study area. Accumulation occurs at Long Point, which is prograding eastward at a rate of 7 m/yr, and in Long Point Bay. A reversal in the eastward drift pattern occurs in Long Point Bay and movement is westward along the southern and northwestern shorelines. The easterly sediment movement pattern resumes in the vicinity of Port Dover and applies throughout the remainder of the study area.

522. St. Lawrence Seaway Development Corporation. 1973. SPAN: A plan for all seasons. In: 1973 annual report. St. Lawrence Seaway Development Corp. The United States Dept. of Transportation. Washington, D. C. pp. 18-19.

Program SPAN is introduced in detail. It is part of the Great Lakes St. Lawrence Seaway Navigation Season Extension Demonstration Program and is officially entitled the System Plan for All-year Navigation. Target date for completion of the project is April, 1974.

523. Stanley Consultants. 1972. Regional storm drainage and flood study, Western Cuyahoga County-Eastern Lorain County. Stanley Consultants. Cleveland, Ohio. 111 p. + 2 appendices + 49 tables.

This report presents the results of a comprehensive and systematic analysis of drainage and flooding problems along the principal drainage arteries in all or portions of the municipalities of Bay Village, Westlake, North Olmsted, Rock River, Fairview Park, Avon and Avon Lake, Ohio. This study features system analysis techniques and a demonstration of the application of computer technology to the mechanisms of storm drainage which interlock with outer urban problems. Numerous computer applications have been utilized to examine hydrologic and hydraulic characteristics of the principal watersheds in the rapidly growing western suburban Cleveland area comprising the study region. (CE)

524. Stefan, H. 1972. Analytical jet-type model of heated water surface plumes. Internat. Assoc. Great Lakes Res. Proc. 15th Conf. Great Lakes Res. pp. 680-688.

The steady flow of heated water from a straight channel into a lake has been investigated analytically and experimentally. A three-dimensional buoyant, jet-type analytical model has been developed to predict the thickness (depth), the main trajectory and the temperature distribution in that portion of a thermal plume where the flow is dominated by the initial momentum and the buoyancy of the discharge and where it has free boundaries. The interaction between turbulent, mixing, buoyant spreading and surface cooling is represented in the model. An integral technique using the entrainment principle and the momentum and heat transfer equations is used. Effects of weak crosscurrents and weak winds are also incorporated. The necessary set of equations is solved by forward extrapolation requiring a minimal amount of computer time. The model is not suitable for thermal plumes which cling to a shoreline due to particular wind or current conditions.

525. Steggles, W. A. 1968. Organization and planning of water quality control. In: Proc. of Great Lakes Water Resources Conf. June 24-26, 1968. Toronto, Canada. pp. 447-470.

Eighteen million people, their livestock and industry pollute the waters of Lake Erie and Lake Ontario. The natural long term quality changes of the lakes have been accelerated by the buildup of mineral nutrients and algae with far-reaching consequences for the water users of the lakes. While waste disposal is essential for life and industry, it must be done in such a way that the highest possible water quality is achieved. The need exists for comprehensive management capable of integrating planning, implementing and maintaining control over water quality in the Great Lakes and their tributary streams to achieve the quality needed for the multiple uses of water. Improved methods and systems are now available to management to attain this objective.

526. Steggles, W. A. and J. Thon. 1968. Effects of waste discharge on harbor areas. Internat. Assoc. Great Lakes Res. Proc. 11th Conf. on Great Lakes Res. pp. 588-592.

Industrial and municipal developments in harbor areas in the Lower Great Lakes have created localized water quality management problems. The Ontario Water Resources Commission has carried out detailed studies of the chemical and physical effects of waste discharges within the harbor areas and adjacent lake waters. Results of 1966 and 1967 studies at the Wheatley harbor are presented to illustrate the waste dispersion, settling and decay patterns encountered in harbor areas. The major parameters considered are BOD, dissolved oxygen, total and soluble phosphate, total and dissolved solids, conductivity, ammonia and turbidity. The effects of waste discharges on the water uses are discussed together with control measures required to protect the uses.

527. Stevenson, A. L. and W. S. Benninghoff. 1969. Late postglacial rise of Lake Erie and changes in vegetation on the Maumee Lake plain. Internat. Assoc. Great Lakes Res. Proc. 12th Conf. on Great Lakes Res. pp. 347-350.

Natural vegetation of the Maumee Lake Plain in northwestern Ohio is composed of mosaics of dry and wet prairie patches, oak openings or savannas, oak-hickory forest, mesophytic hardwood forest, and swamp hardwood forest. The post-glacial sequence and times of arrival of these vegetation elements are in question, but there is evidence from vegetation and soils that swamp and marsh communities have been expanding in recent centuries.

A 2 m long core with a buried forest layer at its base was recovered from Terwilliger's Pond at Put-in-Bay Harbor, South Bass Island, in Western Lake Erie. Coniferous wood from the forest bed yielded a radiocarbon date of 2,500± 270 years BC. The 5 cm thick layer recovered from the forest soil contains dicotyledonous wood, tissue fragments from broad leaves, and abundant fungus mycelia in a matrix of subaerially decayed black amorphous muck. Mesic site conditions with mull humus are indicated. The forest bed is overlain successively by fibrous (marsh?) peat, pond ooze, and allochthonous detrital peat. If the pond basin has not subsided due to solution of gypsum layers in the underlying bedrock, the stratigraphy and sequence of fossil pollen argues for a rise in lake level of at least 3 m since 550 BC.

It is probable that this dated evidence for relatively recent rise in lake level is causally linked with extension of wet soils and hydric plant communities on portions of the Maumee Lake Plain through the raising of stream base levels.

528. Stewart, K. M. 1973. Winter conditions in Lake Erie with reference to ice and thermal structure and comparison to Lake Winnebago (Wisconsin) and Mille Lacs (Minnesota). Internat. Assoc. Great Lakes Res. Proc. 16th Conf. Great Lakes Res. pp. 845-857.

A flotation-equipped helicopter was utilized to obtain data on ice thickness, extent of ice coverage and thermal conditions at 50 to 83 stations in Lake Erie from February to April 1972. Without considering pressure ridges and areas of ice rafting, the average (1972) maximum ice thickness in the Western, Central and Eastern Basins was about 25, 18, 26 cm respectively.

In contrast to findings from smaller ice-covered lakes, Lake Erie has little to no vertical stratification during winter. In addition, the water temperatures are unusually cold. For example, in early March during one of the sampling periods, most of the water throughout the lake was less than 1° C. Thus Lake Erie tends to behave not as a dimictic lake, but rather as an extremely well-mixed monomictic lake, even though it is covered extensively with ice.

Part of the reason for the cold water and lack of stratification is that the ice sheet acts as a giant movable "sieve" with irregular openings and with some portions sealed completely.

By comparison, a well-developed vertical stratification and parabolically shaped isotherms were found beneath the total ice cover of Lakes Winnebago (Wisconsin) and Mille Lacs (Minnesota).

The 1972 winter transects on Lake Erie suggest no obvious problems of waste heat disposal.

529. Stewart, R. 1969. Thermal discharge from nuclear plants and related weather modification. Internat. Assoc. Great Lakes Res. Proc. 12th Conf. Great Lakes Res. pp. 488-491.

The volume of thermal discharge from power plants is increasing at a rate which suggests that the discharge will cause inadvertant weather modification. A 10^3 MW nuclear power plant uses approximately 10^6 gal/min of which 10^4 gal/min evaporates. This is sufficient to reduce visibility and increase fogging in the area of discharge. Beneficial uses of thermal discharge are suggested and calculations are presented to indicate that waste heat released by a dry closed-circuit cooling system is sufficient to dissipate fog and increase visibility.

530. Stewart, R., U. Czapski and R. T. Nelson. 1973. Meteorological effects of spray cooling in the Great Lakes climate. Internat. Assoc. Great Lakes Res. Proc. 16th Conf. on Great Lakes Res. pp. 603-614.

The concept of cooling a thermal discharge by the use of a spray cooling pond was examined in terms of efficiency of spray nozzles, meteorological effects, such as drift and icing, and natural cooling. A 15 x 9 x 1.2 m. pond was constructed with auxiliary heating capability. The spray (340 ℓ, single nozzle, and 950 ℓ, double nozzle) was monitored for temperature changes which were up to 8° C. Drift was recorded up to 22 m downwind, with evidence of it occurring over 60 m. downwind from the spray. Icing at three levels indicated three ranges of deposition, dependent upon temperature and incident solar radiation. Heat loss from the spray exceeded 134 kcal/hr/ℓ during high ΔT (pond termperature minus air temperature). These data are especially applicable to cooling during an emergency shutdown (accident), where auxiliary spray ponds may be used.

531. Strazisar, A. and J. Prahl. 1973. The effects of bottom friction on river entrance flow with crossflow. Internat. Assoc. Great Lakes Res. Proc. 16th Conf. Great Lakes Res. pp. 615-625.

Experimental results are presented for the trajectory of a rectangular non-buoyant jet entering perpendicular to a crossflow of constant depth equal to that of the jet. A comparison with theoretical predictions based on a momentum integral approach including bottom friction is made. The experimental investigation was carried out on a 1.73 x 6.1 m. water table, using constant temperature hot-film anemometry for velocity measurements and photographic techniques with dye injection for streamline traces. Results indicate that the penetration of the jet depends on the ratio of the initial jet velocity to crossflow velocity, the initial jet Reynolds number, the jet width-to-depth ratio, γ, and the channel width-to-jet width ratio, w/b_o. Large values of γ increase the effect of bottom friction on the jet, thus decreasing the jet penetration. Predictions, based on analysis and laboratory experiments, for the Cuyahoga River entering Lake Erie are compared to field observations of the Cuyahoga River.

532. Sturman, G. M., P. H. Gilbert and J. P. Wolfner. 1971. Systems engineering for urban utilities. J. Am. Water Works Assoc. 63(9):564-570.

Any large city must assess its water supply and distribution system and plan changes for the future. This paper describes the methodology employed in the analysis of the Cleveland municipal system along with the reasons for its adoption. (BECPL)

533. Sundaram, T. R. 1973. A theoretical model for the seasonal thermal cycle of deep temperate lakes. Internat. Assoc. Great Lakes Res. Proc. 16th Conf. Great Lakes Res. pp. 1009-1025.

It is shown that a length scale which can be formed from the wind stress that is exerted at the surface of a lake and the heat flux at the surface of the lake can be used to determine the key features of the stratification cycle of temperate lakes. This length scale is a measure of the depth to which a given surface heat income can be distributed by wind mixing, so that it can be used to determine the time of beginning and end of summer stratification. The time evolution of the depth of the thermocline is also calculated in terms of the length scale. The calculated

values compare well with the available data for Lake Michigan. The role of this length scale and certain similarity parameters which can be formed using it and the morphometric features of a lake are shown to be of great value in the classification of lakes. The techniques developed are used to compare and contrast the thermal structures of the five Great Lakes. The role of the length scale in interpreting such phenomena of importance as the thermal bar is also discussed briefly.

534. Sutherland, J. C. 1970. Silicate mineral stability and mineral equilibria in Great Lakes. Env. Sci. and Tech. Paper 37334. 4(10):826-33.

Equilibrium concepts involving silicate minerals and water are applied to chemical data from the North Channel and Lake Erie, Ontario, and Huron, for understanding of chemical self-regulation in the Great Lakes. Equilibria involving silicates and water are inferred from aqueous chemical data. The equilibrium model was found useful to explain chemical self-regulation of the Great Lakes in regions of low-population density. 30 references. (UB)

535. Sveum, D. L. 1970. The quantity and quality of sediments deposited in Cleveland Harbor at Cleveland, Ohio. Proc. Seminar on Sediments Transport in Rivers and Reservoirs. 16 p + 5 plates.

It is the purpose of this paper to discuss some of the results of the pilot study and to focus attention on the problems of a specific harbor on the Great Lakes. Cleveland Harbor, situated along the lower reaches and at the mouth of the Cuyahoga River, has been selected as the topic for this paper because considerable data are available for this situation and the magnitude of the sedimentation problem in this harbor is one of the largest on the lakes. (CE)

Sweeney, Robert A. - See: J. Hassen, No. 294.

536. Sweeney, Robert A. 1969. The Great Lakes Laboratory of the State University College at Buffalo. Limnos. 3(1):13-17.

This article gives a description of the structure and mode of operation of the Great Lakes Laboratory supported by the university system. The mission of the Great Lakes Laboratory and the number of diverse problems it has been able to attack are discussed.

537. Symons, G. E. and W. L. Torrey. 1941. Estimation of total solids in sludges by centrifuging. Water Works and Sewage. 88(3):106-108.

The paper reports the special centrifuging equipment used in Bird Island Laboratory of the Buffalo Sewer Authority, Buffalo, New York, for determining total solids in sewage sludge. (UB)

538. Tarbox, R. M. 1968. A new problem in the maintenance of Great Lakes harbor depths. Internat. Assoc. Great Lakes Res. Proc. 11th Conf. Great Lakes Res. pp. 664-667.

In early 1967, the Corps of Engineers instituted a Pilot Program on Disposal of Polluted Dredgings from Great Lakes Harbors. The Federal Water Pollution Control Administration (FWPCA) and other agencies are cooperating in the program. Under the Pilot Program, the Corps is testing the effectiveness and comparing costs of different types of disposal areas, of various methods of handling dredged material and of methods of treating the effluent from the disposal areas. The data are being obtained at various representative harbors, with the degree of pollution varying from heavy to negligible. FWPCA and the Corps are sampling water and bottom sediments at the dredging areas and in the vicinity of the alternate disposal areas and conducting various tests on the samples. The objective is to determine means of disposal and management of dredged materials so that they will not degrade the water quality of the lakes. The Corps is working to complete its investigations and to prepare a report by December, 1968.

539. Terraneers, Limited. 1971. Disposal of waste effluents in Northeastern Ohio. Terraneers, Limited. Painesville, Ohio. 31 p.

The purpose of this study was to broadly evaluate the potential of sewage waste disposal within the soils and bedrock of Northeastern Ohio. This area was selected by the Corps of Engineers as one of four "test" areas wherein the concept of subsurface disposal of such wastes will be evaluated. In this report we have "painted" sixteen counties with a "broad brush"--a necessary prelude to the selection of favorable areas for more detailed examination. (CE)

540. Thayer, P. M. 1953. Milk waste treatment by activated sludge. Waste and Sewage Works. 100(1):34-37.

Operating features and results at Germantown, Dayton and Toledo are reported. Both milk waste and sludge are treated in one operation. Factors involved in the design of an activated sludge plant are discussed by consideration of the small milk processing plant with a daily milk intake of 30,000 lbs. Flow diagram illustrates unit relation in activated sludge treatment of milk wastes. (UB)

541. Thomas, E. B. 1913. The Cuyahoga River in the flood of March 25-26, 1913. Eng. News. 69(18):922-924.

The flood of the Cuyahoga River in March 25-26, 1913, is reported. Causes are examined and prevention plans are discussed. (BL)

542. Thomas, M. K. 1964. A survey of Great Lakes snowfall. Univ. Mich. Great Lakes Res. Div. Great Lakes Res. Div. Pub. 11:294-310.

Snowfall in the Great Lakes basin is produced by both large scale cyclonic storms and by the relatively small lake effect storms. Considerable literature concerning these lake effect storms has been published over the past few decades. Lake effect snowfall seems to be more subject to fluctuations from year to year and from decade to decade than snowfall from general cyclonic storms. In this survey no attempt has been made to delve into the problems and progress of snowfall forecasting in the Great Lakes region. Similarly, little or no mention has been made of snow cover, or of the water equivalent of snowfall and snow cover.

543. Thomas, R. L. 1969. A note on the relationship of grain size, clay content, quartz and organic carbon in some Lake Erie and Lake Ontario sediments. J. Sedimentary Petrology. 39(2): 803-809.

An examination of the geochemistry of fine-grained sediments in relation to size frequency distribution was carried out on sediment samples from Lakes Erie and Ontario. This study demonstrated a direct relationship between the <2 micron grain size and the theoretical clay content computed

from the organic carbon, quartz and carbonate content. A sympathetic relationship was observed between clay content and organic carbon, and also between median grain size and quartz content. The former relationship is believed to be the result of absorption from solution and the latter is brought about by natural sedimentation from suspension.

544. U. S. Army Corps of Engineers. 1874. Bridging the channel between Lakes Huron and Erie. 43rd Congress, 1st Session. House Document 64. 69 p.

A report of the board of engineer officers is given regarding the practicability of bridging, consistent with the interests of navigation, the channel between Lake Huron and Lake Erie at such points as may be needful for the passage of railroad trains across said channel. (CE)

545. U. S. Army Corps of Engineers. 1896. Resurvey of Fairport Harbor, Ohio. 54th Congress, 1st Session. House Document 347. 4 p. + map.

A survey report of Fairport Harbor is given. Construction of east and west breakwaters is recommended. A proposed plan to secure a reliable depth of 25 feet at the outer entrance is reported in view of the cost and benefits. (CE)

546. U. S. Army Corps of Engineers. 1899. Regulation of the level of Lake Erie. 56th Congress, 1st Session. House Document 200. 26 p. + illustrations.

Methods for regulating Lake Erie level are discussed. The board is of the opinion that the best location for works for regulating the level of Lake Erie is at the foot of the lake just below Buffalo Harbor. The works projected by the board are designed to distribute the discharge of the lake so as to reduce its variation of level to a small amount. The result can not be attained by the use of submerged fixed weirs only, and a series of sluices are added to secure, in combination with fixed weirs, the control desired. (CE)

547. U. S. Army Corps of Engineers. 1900. Examination and plan and estimate of cost of improving Cleveland Harbor, Ohio. 56th Congress, 2nd Session. House Document 118. 17 p. + pictures + map + illustrations

Preliminary examination of Cleveland Harbor, Ohio, with a view to the further improvement of the harbor, first, by such additional construction or extension necessary to provide a safer and better entrance for vessels at the main entrance to the breakwater, and second to provide such additional harbor room as may be found necessary by an extension eastward of the breakwater now under construction.

548. U. S. Army Corps of Engineers. 1910. Dunkirk Harbor, New York. 61st Congress, 2nd Session. House Document 720. 11 p. + map.

This report gives a preliminary examination and survey of Dunkirk Harbor, New York. In view of the fact that there is no commercial use made of the channel and none in prospect, widening, straightening and deepening of the channel is not deemed necessary. After cost and benefits study of harbor improvement, it is concluded that Dunkirk Harbor is unworthy of improvement beyond the maintenance of the existing project. (CE)

549. U. S. Army Corps of Engineers. 1910. Regulation of Lake Erie. 61st Congress, 2nd Session. House Document 779. 158 p. + 29 plates.

The term "regulation of a lake's level" means the maintenance of its level at or near some fixed stage, which implies such control of the discharge as will make the latter nearly equal to the total supply-rainfall and inflow, less evaporation - at all times. The methods of regulation are reviewed in this report. Ice jams and regulation of Lake Erie between the limits 572.0 and 574.5 feet (1903 levels) are discussed. Advantages and disadvantages of regulation and recommended regulation plans are also discussed. (CE)

550. U. S. Army Corps of Engineers. 1914. Cuyahoga River, Ohio. 63rd Congress, 2nd Session. House Document 707. 96 p. + maps.

This is a report of a survey and an estimate of the cost of improving the Cuyahoga River, Ohio, from its mouth to a more southerly connection with the Ohio Canal with a view to eliminating bends and securing a navigable depth of 21 feet with suitable width. (CE)

551. U. S. Army Corps of Engineers. 1916. Lorain Harbor, Ohio. 64th Congress, 1st Session. House Document 980. 9 p. + map.

In connection with the general project for the improvement of this harbor, there have been constructed an east and west breakwater, respectively 2300 and 3300 feet in length, the inner ends being some distance from the shore line. The reuslts of the preliminary examination and survey indicate that erosion of the shore line has taken place in recent years and that this erosion on the west side of the harbor is largely due to the construction of the west breakwater, but that any erosion that may have taken place on the east side of the harbor has not been caused by the Government breakwater. The material eroded from the west side is carried into the harbor and is encroaching upon the dredged area, and the district officer states that the only means of securing permanency of depth in the harbor appears to be by extending the breakwater to the shore. (CE)

552. U. S. Army Corps of Engineers. 1916. Lorain Harbor, Ohio. 64th Congress, 1st Session. House Document 985. 11 p. + map.

The improvement project for Lorain Harbor is described. The existing project provides for an outer harbor about 60 acres in area, created by converging breakwaters with an aggregate length of 5,600 feet and having an entrance 500 feet wide between pierheads located at the outer ends of the breakwaters and 1,800 feet outside the entrance to the channel between the piers; for dredging shoal areas in the outer harbor to a depth of 21 feet below mean lake level; for parallel piers at the mouth of the river 300 feet apart and having an aggregate length of 2,765 feet; and for dredging the channel between the piers and upstream to the Erie Avenue highway bridge, a length of about 3,000 feet, to a depth of 20 feet below mean lake level. The estimated cost of the work is given. (CE)

553. U. S. Army Corps of Engineers. 1918. Black River at Lorain, Ohio. 65th Congress, 2nd Session. House Document 1200. 11 p. + map.

Report is given on a preliminary examination of Black River at Lorain, Ohio. The existing project provides for an outer harbor protected by breakwaters and a channel 20 feet deep at low water datum between parallel piers and upstream to the Erie Avenue Highway Bridge, a distance of about 3000 feet. A channel improvement plan is also recommended. (CE)

554. U. S. Army Corps of Engineers. 1919. Lorain Harbor, Ohio. 66th Congress, 1st Session. House Document 254. 12 p. + map.

Lorain Harbor, Ohio is reported with a view to the extension of the east breakwater and enlarging and deepening the harbor area. A preliminary examination and survey are also presented and discussed. (CE)

555. U. S. Army Corps of Engineers. 1926. Fairport Harbor, Ohio. 69th Congress, 2nd Session. House Document 592. 20 p. + map.

A preliminary examination of Fairport Harbor is given. The district engineer is of the opinion that the benefits to be derived from the desired improvement will be incommensurate with its large cost. A survey is followed in which the outer harbor of Fairport Harbor, with a view to extending the breakwater and making such other improvements as may be necessary to the enlargement of the harbor, is reported. (CE)

556. U. S. Army Corps of Engineers. 1930. Conneaut Harbor, Ohio. 73rd Congress, 1st Session. House Document 48. 34 p. + map.

The board recommends modification of the existing project to provide for deepening a part of the outer harbor to accommodate vessels of 24-foot draft; for extension of the east and west breakwaters and removing the outer arm of the west breakwater; for removing the Federal-owned west pier and a part of the cast pier; for modifying the dredging limits and deepening the additional areas; for eliminating the present authorization for a 255-foot shoreward extension on the west breakwater; and for extending the west breakwater to shore. (CE)

557. U. S. Army Corps of Engineers. 1932. Cleveland Harbor, Ohio, including the channel in Cuyahoga and Old Rivers. 72d Congress, 2d Session. House Document No. 477. 39 p. + map.

It was concluded that the water-borne commerce of Cleveland Harbor is sufficient in quantity and character to warrant greater depths in the entrance channel, in the west basin of the outer harbor, and in the inner harbor; removal of 150 feet of the east end of the west breakwater; and protection of the west gap against heavy surges from the lake and excessive shoaling in the west basin. Further, it is believed that deepening Old River and Cuyahoga River above the present project limit is the responsibility of local interests. (CE)

558. U. S. Army Corps of Engineers. 1932. Fairport Harbor, Ohio. 72nd Congress, 2nd Session. House Document No. 472. 32 p. + map.

The Board of Engineers for Rivers and Harbors recommends deepening the Federal Project area to 25 feet in soft and 26 feet in hard material; widening to 300 feet the river channel at the mouth and extending the west breakwater 500 feet. An estimated cost of work is also provided. (CE)

559. U. S. Army Corps of Engineers. 1932. Huron Harbor. 72nd Congress, 2nd Session. House Document No. 478. 34 p. + map.

The Board of Engineers for Rivers and Harbors recommends modification of the existing project to provide for widening the entrance channel and deepening it to 25 feet in soft material and 26 feet in hard material; for enlarging and deepening to 19 feet the existing turning basin; for extending the West Pier 1,200 ft. lakeward; for the removal of the outer end of the east breakwater; for extending the shore protection at the inner end of the west pier 200 feet westward and for eliminating from the project the spur pier now authorized and the dredging of the sheltered area. (CE)

560. U. S. Army Corps of Engineers. 1932. Lorain Harbor, Ohio. 72nd Congress, 2nd Session. House Document. No. 469. 31 p. + map.

The Board of Engineers for Rivers and Harbors recommends deepening the present Federal Project's area to 25 feet in soft material and 26 feet in hard material. It further recommends that the United States widen the first two bends in the Black River above the New York, Chicago and St. Louis Railroad Bridge and enlarge the winding basin near the National Tube Co.'s dock. Cost estimation is also provided for each project. (CE)

561. U. S. Army Corps of Engineers. 1934. Lorain Harbor, Ohio. 73rd Congress, 2nd Session. 16 p. + map.

This is a report of Lorain Harbor. The district engineer is of the opinion that modification of the recommendation made in House Document No. 469, 72nd Congress, 2nd Session, is justified to provide for dredging to a depth of 16 feet below low water datum in the west outer harbor between the present project limits and a line parallel to and 20 feet from the established harbor line for a width of 1,250 feet. No dredging is to be done within 50 feet of the west pier or within 100 feet of the center line of the west breakwater. (CE)

562. U. S. Army Corps of Engineers. 1935. Lorain Harbor, Ohio. 74th Congress, 1st Session. House Document No. 51. 27 p. + map.

The document under review contains preliminary examination and survey reports in which the Chief of Engineers recommended further improvement of Lorain Harbor to provide for widening two bends above the limits of the present Federal project to a depth of 20 feet and of the turning basin at the National Tube Co.'s dock to a depth of 17 feet and for deepening within the limits of the present project to 25 feet in soft material and 26 feet in hard material. (CE)

563. U. S. Army Corps of Engineers. 1936. Cleveland Harbor, Ohio. 74th Congress, 2nd Session. House Document No. 84. 41 p. + 2 maps.

This report concludes: (a) the facts in the case warrant adequate maintenance of the Cuyahoga and Old Rivers to 21 feet at Federal expense in the interests of general commerce and navigation, (b) the proposed widening at bends and in the channels, with channels' depths of not to exceed 21 feet, will result in saving in time to vessels and will reduce hazards in navigation, (c) the time which will probably be needed by local interests to work out their part of the plan may be expected to be considerable. (CE)

564. U. S. Army Corps of Engineers. 1937. Rocky River Harbor, Ohio. 75th Congress, 1st Session. House Document No. 70. 18 p. + map.

The board recommends modifications of the existing project to provide for an east entrance pier 900 feet in length to be secured by a lakeward extension of the present pier, and an entrance channel 100 feet wide and 10 feet deep extending from that depth in the lake to a point 600 feet inside the inner end of the pier. (CE)

565. U. S. Army Corps of Engineers. 1939. Cleveland Harbor, Ohio. 76th Congress, 1st Session. House Document No. 232. 28 p. + map.

The prospective benefits to be derived from provision of the desired channel extension in the Cuyahoga River are insufficient to justify the cost of its construction. The desired turning basin is considered a reasonable and necessary improvement in view of the large amount of vessel traffic in the upstream portion of the improved channel in Cuyahoga River, and the prospective benefits to be derived are sufficient to justify its construction. (CE)

566. U. S. Army Corps of Engineers. 1940. Lorain Harbor, Ohio. 77th Congress, 1st Session. House Document No. 161. 18 p. + map.

Report of the reexamination of Lorain Harbor is discussed. Local interests request the extension of the east breakwater at Lorain Harbor, Ohio, to increase outer harbor mooring facilities and protect the adjacent shore from erosion, the construction of a bulkhead along the east river pier to the Coast Guard station, and the widening of the river channel at the bend just above the Baltimore and Ohio Railroad Co.'s coal dock to facilitate turning of vessels. (CE)

567. U. S. Army Corps of Engineers. 1944. Emergency relief of farm lands in Lucas County, Ohio. 78th Congress, 2nd Session. 20 p.

The hearing before the sub-committee of the Committee on Commerce, United States Senate, 78th Congress, 2nd Session, is on a bill to authorize emergency relief and rehabilitation of farm lands in Lucas County, Ohio, from damage resulting from the extraordinary floods of July and October 1943. Repair and reconstruction dikes and levees along the south shore of Lake Erie, dewatering and decontaminizing the area are required. (BECPL)

568. U. S. Army Corps of Engineers. 1945. Beach erosion study, Ohio shoreline of Lake Erie from Ohio-Michigan state line to Marblehead, Ohio. 79th Congress, 1st Session. House Document No. 177. 27 p. and maps.

Report together with accompanying papers and illustrations, on a study of beach erosion of the Ohio shoreline of Lake Erie from the Ohio-Michigan state line to Marblehead, Ohio. Erosion of this shore has been continuous and rapid but that protection of the shore should be provided only when found to be economically justified. It was recommended that Reno Beach be protected by an earth dike. (CE)

569. U. S. Army Corps of Engineers. 1950. Cleveland and Lakewood Ohio beach erosion control study. 81st Congress, 2nd Session. House Document No. 502. 56 p., maps, and charts.

Report with papers and illustrations, on a cooperative study for beach-erosion control at Cleveland and Lakewood, Ohio. The improvement of Edgewater Park and Perkins Beach by the construction of an artificial beach with its attendant system of groins was determined to be the most desirable and effective of the several methods which could be employed with confidence to provide necessary protection. (CE)

570. U. S. Army Corps of Engineers. 1950. Shore of Lake Erie in Lake County, Ohio, beach erosion control study. 81st Congress, 2nd Session. House Document No. 596. 34 p., maps, and charts.

Papers and illustrations, on a cooperative beach erosion control study of the shore of Lake Erie in Lake County, Ohio. The most economical and practical method of protection against erosion of privately owned property between the mouth of the Chagrin River and Fairport Harbor, Ohio, is grading and landscaping of the bluffs, revetment of the toe of the slope and maintenance of relatively narrow beaches by means of short groins. Further improvement of the proposed State Park beach or of other public beaches within the study area was not warranted at the time. (CE)

571. U. S. Army Corps of Engineers. 1952. Appendix VIII, Ohio shoreline on Lake Erie between Vermilion and Sheffield Lake Village, beach erosion control study. 83rd Congress, 1st Session. House Document 229. 44 p., maps and illustrations.

The purpose of this cooperative beach erosion study is to determine effective and economical methods of shore protection and beach stabilization from Vermilion to Sheffield Lake Village with particular emphasis on the proposed Beaver Creek State Park and the publicly owned shore at Waverly, Lakeview, Riverside, and Century Parks in the city of Lorain. It is recommended that the city of Lorain continue maintaining the shore at Riverside Park by dumping waste materials, and that the same shore plan be adopted for the shore at Waverly Park; and if the city desires to improve its beach at Century Park, it should adopt the plan of improvement described in the report. (CE)

572. U. S. Army Corps of Engineers. 1952. Appendices V and X, Ohio shoreline of Lake Erie between Ashtabula and Pennsylvania state line, beach erosion control study. 82nd Congress, 2nd Session. House Document 350. 37 p., maps and charts.

Report on a cooperative beach erosion control study of the Ohio shoreline of Lake Erie between Ashtabula and the Pennsylvania state line. Conneaut Township Park is the only publicly owned property requiring further improvement and protection at this time. The plan of improvement most suitable for the protection and improvement of Conneaut Township Park frontage is the construction of a groin to concentrate the supply of natural littoral drift along the frontage now experiencing erosion. (CE)

573. U. S. Army Corps of Engineers. 1952. Appendices III, VII, and XII, Ohio shoreline of Lake Erie between Fairport and Ashtabula, beach erosion control study. 82nd Congress, 2nd Session. House Document No. 351. 46 p., maps, and charts.

A report on a cooperative beach erosion control study of the Ohio shoreline of Lake Erie between Fairbort and Ashtabula. After full consideration of the reports of the district and division engineers, the Beach Erosion Board concludes that the need for protection of the publicly owned sections of the shore within the study area is insufficient to warrant Federal aid. If local interests desire to improve Lake Shore Park at Ashtabula, Ohio, it is recommended that they adopt one of the two plans considered in this report. The only publicly owned properties are Perry Township, Geneva Township Park, and Lake Shore Park at Ashtabula, Ohio. (CE)

574. U. S. Army Corps of Engineers. 1953. Appendix VI, Ohio shoreline of Lake Erie, Sandusky to Vermilion, Ohio, beach erosion control study. 83rd Congress, 1st Session. House Document No. 32. 40 p.

For Cedar Point extending westerly from the new entrance road, the most suitable plan is the restoration of adequate beach widths by artificial fill and provision of excess material near the new entrance to act as a feeder beach. Throughout the remainder of the study area such limited beach areas as now exist should be maintained by the use of groins. In general, the creation of new beaches would require artificial fill because of the scarcity of natural beach building material. Plans have been prepared for stone revetment and a sea wall which will provide protection against erosion at any locality. (CE)

575. U. S. Army Corps of Engineers. 1953. Appendix IV, Ohio shoreline of Lake Erie, Sandusky Bay, Ohio, beach erosion control study. 83rd Congress, 1st Session. House Document No. 126. 16 p. and map.

The purpose of this beach erosion control study was to determine effective and economical methods of protecting approximately 2 miles of privately owned shoreline on the south shore of Sandusky Bay in Townsend Township, Sandusky County, Ohio. As a result of this study, it is concluded that the most economical method of protection against erosion of this shore is the use of quarry-stone revetment. It is recommended that owners of private

property either individually or by cooperative action construct continuous sections of revetment, wherever possible, based on their own determination of the economic justification for the protection. (CE)

576. U. S. Army Corps of Engineers. 1953. Appendix XIV, Ohio shoreline of Lake Erie, Sheffield Lake Village to Rocky River, beach erosion control study. 83rd Congress, 1st Session. House Document No. 127. 44 p., maps, and illustrations.

The purpose of this beach erosion control study is to determine effective and economical methods of shore protection and beach stabilization of the Ohio shoreline of Lake Erie between Sheffield Lake Village and Rocky River, a distance of approximately 15 miles. As a result of this study, it is concluded that because of the predominance of shale bluffs and the lack of adequate natural sources of sand for beach building, the most practicable general plan of protection is some form of seawall or stone revetment. Plans were also requested for construction of beaches for shore protection and recreational use. It is concluded that any new beach areas will require artificial fill and groins. (CE)

577. U. S. Army Corps of Engineers. 1953. Presque Isle Peninsula, Erie, Pa., beach erosion control study. 83rd Congress, 1st Session. House Documents No. 231. 57 p., maps, and profiles.

As a result of this study it is concluded that an economically justified plan of improvement which will best provide protection and improvement of Presque Isle Peninsula is an overall plan of a continuous beach created by artificial placement of sand, construction or remodeling of groins to reduce the rate of erosion of the rebuilt beach areas, and the construction of a bulkhead to form a continuous line of last defense in the event of sudden and temporary loss of any section of beach. (CE)

578. U. S. Army Corps of Engineers. 1954. Appendix XI, Ohio shoreline of Lake Erie, Euclid to Chagrin River, beach erosion control study. 83rd Congress, 2nd Session. House Document No. 324. 39 p., maps, and illustrations.

The purpose of this beach erosion control study was to determine effective and economical methods of shore protection and beach stabilization of the Ohio shoreline of Lake Erie between the east city line of Cleveland and the mouth of the Chagrin River. As a result of this study, it is concluded that there is sufficient beach material available to provide beaches of the minimum width necessary to protect the bluffs from erosion by wave action for a large part of the study area. Plans have been prepared for groins designed to impound protective beaches of minimum width necessary to protect the bluffs. Plans have also been prepared for the protection of the shore by seawalls and stone revetment. (CE)

579. U. S. Army Corps of Engineers. 1957. Cleveland Harbor, Ohio. 85th Congress, 1st Session. House Document No. 107. 41 p. and map.

The improvements considered in this report consist of: (a) deepening a channel generally 500 feet wide through the east basin to a project depth of 25 feet; (b) channel widening in the left bank of Cuyahoga River; and (c) widening in the north bank of Old River in the vicinity of the bridges, and three points in the south bank. The large amounts of benefits through transportation savings fully justify improvements. (CE)

580. U. S. Army Corps of Engineers. 1960. Hopper dredges. Corps of Engineers, Buffalo District. Buffalo, N.Y. 20 p.

Arriving in Cleveland Harbor after her 4,000 mile voyage from New Orleans, the MARKHAM was commissioned amidst pomp and pageantry by the Secretary of the Army on May 17, 1960. Following this royal fete she was assigned to deepening portions of the Connecting Channels in Western Lake Erie.

Like other Corps dredges on the Great Lakes, the MARKHAM operates 24 hous a day, six days a week from mid-March until mid-December, when lake ice prevents operation.

581. U. S. Army Corps of Engineers. 1960. Proposed relocation of north entrance channel, Buffalo Harbor, Buffalo, New York. Corps of Engineers. Buffalo District. Buffalo, N.Y. Tech. Rept. 2-536. 19 p., 13 plates, 7 p. supplementary.

Relocation of the north entrance channel to the harbor would necessitate removal of 800 feet of a section of existing Old Breakwater; 1:25 scale fixed-bed harbor model was used to determine proper position and minimum length of detached breakwater that will limit wave action in the harbor; tests indicated use of detached 1,800 feet long breakwater, located on the north side of the new channel for protection.

582. U. S. Army Corps of Engineers. 1961. Great Lakes harbors study-interim report on Huron Harbor, Ohio. 87th Congress, 1st Session. House Document No. 165. 48 p. and map.

It has been determined in this interim report to the Great Lakes harbors study that the most advisable plan for modification of Huron Harbor to permit efficient use of this harbor by vessels utilizing the deepened Great Lakes Connecting Channels and the St. Lawrence comprises increasing the depths from the present controlling depth of 24 feet to a controlling depth of 27 feet, enlarging the turning basin in the river and constructing a detached breakwater. (CE)

583. U. S. Army Corps of Engineers. 1962. Great Lakes harbors study--second interim report on Cleveland Harbor, Ohio. 87th Congress, 2nd Session. House Document No. 527. 78 p. and map.

It has been determined in this interim report that two plans of improvement, plan A and plan B, would be advisable to permit utilization of large deep draft vessels transporting to and from terminals in the east basin. Plan A would provide for an area with a depth of at least 27 feet extended easterly about 3,800 feet from the existing 28-foot project area. Plan B would provide for a dock approach channel to the Nicholson Cleveland Terminal Company pier 25 feet deep. The improvements would return substantial benefits through reduction of cost of transporting. (CE)

584. U. S. Army Corps of Engineers. 1962. Great Lakes harbor study-interim report on Conneaut Harbor, Ohio. 87th Congress, 2nd Session. House Document No. 415. 75 p. + map.

The recommended plan of improvement of Conneaut Harbor is reported. The recommended improvement of the city dock channel will provide for continuance of commercial fishing operations in a safe and economical manner. The plan includes (1) dredging west outer harbor to 22 feet in earth and 23 feet in hard material; (2) dredging east outer harbor to 28 feet in earth and 29 feet in hard material; (3) dredging entrance channel to city dock to 8 feet; (4) construction of an 1150 foot extension of east breakwater (5) removal of east pier and (6) dredging inner harbor to 27 feet in earth and 28 feet in hard material. (CE)

585. U. S. Army Corps of Engineers. 1962. Review of report on Sandusky River, Ohio, for flood control. Corps of Engineers, Buffalo District. Buffalo, N.Y. 56 p. + 4 Appendices.

There has been considerable flood damage in the Sandusky River basin since 1913. Local protection works consisting principally of channel improvement and levees, would be economically justifiable at Fremont and Bucyrus and local interests have expressed their willingness and ability to cooperate in construction works. The same works plan has been examined for other areas; some are economically justifiable, some are not. This report gives a comparison among the benefits of the flood control plan. (CE)

586. U. S. Army Corps of Engineers. 1962. Shore of Sheffield Lake Community Park, Ohio, beach erosion control study. 87th Congress, 2nd Session. House Document No. 414. 44 p. and map.

The purpose of this cooperative beach erosion control study is to determine the best means of protecting the Lake Erie shore at a public park in Sheffield Lake Village, Ohio, against erosion from wave action and of restoring and improving a sand beach to provide a public bathing beach. As a result of this study, the most suitable works to accomplish all the objectives of the improvement were determined. (CE)

587. U. S. Army Corps of Engineers. 1963. Design Memorandum on Local Flood Protection Smokes Creek at Lackawanna, New York. Corps of Engineers, Buffalo District, Buffalo, N.Y. 23 p. + 14 plates + appendix.

Design Memorandum on Local Flood Protection Smokes Creek at Lackawanna, New York, includes: (1) a discussion of wave attack and its effects on the jetty cells and the downstream portion of the channel; (2) consideration should be given to providing riprap for prevention of scouring at the base of the cells resulting from wave action against the vertical jetty and walls; (3) gravel fill should be used for the proposed jetty cells unless the District has, or can obtain, information that the proposed slag is not corrosive; (4) only granular, non-cohesive fills should be used in sheet pile wing-wall cells so that adequate fill strengths may be obtained and the interlocks not over stressed; (5) drainage should be provided under the channel slabs.

588. U. S. Army Corps of Engineers. 1964. Rocky River Harbor, Ohio. 88th Congress, 2nd Session. House Document No. 352. 58 p. + map.

The recommended plan of improvement provides for the immediate needs of small boat recreational traffic at and near Rocky River Harbor, Ohio. The improvement provides for a defined channel with adequate depths in Rocky River for safer and easier maneuvering of boats moored along the river and boats launched at the ramp at the upstream end of the project. A cost and benefit analysis is provided for reference. (CE)

589. U. S. Army Corps of Engineers. 1965. Flood plain Information Report Smokes Creek City of Lackawanna, N.Y. Corps of Engineers, Buffalo District, Buffalo, N.Y. 37 p. + exhibits + tech. appendix.

This report is directed primarily at two groups of people in the city of Lackawanna. First, it is written to provide planners and city officials with technical information on possible future flooding from Smokes Creek. The second group to whom the report is directed consists of the residents of Lackawanna--particularly present and prospective property owners. It is emphasized that flood plain regulation will have little effect on existing damages but is designed primarily to prevent damages that would otherwise occur to future development. (CE)

590. U. S. Army Corps of Engineers. 1965. Review report on Buffalo Harbor, New York, Black Rock Channel and Tonawanda Harbor,New York, Niagara River, New York and tributary waterways. Corps of Engineers, Buffalo District. Buffalo, N.Y. 31 p. + maps.

This review report is limited to an investigation to determine the advisability of establishing a separate project for the collection, removal and disposal of drift in Buffalo Harbor, Black Rock Channel and Tonawanda Harbor, Niagara River and in the tributary waterways considered to be a source of drift which would enter these project areas. It is concluded that the establishment of a separate project for the removal of drift in those mentioned areas is warranted for general navigation. The considered improvement would result in substantial savings through reduction in damage and harbor maintenance costs.

591. U. S. Army Corps of Engineers. 1965. Water levels of the Great Lakes--report on lake regulation. Main report. Corps of Engineers. North Central Div. Chicago, Ill. 57 p. + 13 plates.

The purpose of this report is to present the study plans developed in the investigation to date for regulation of the Great Lakes, and to summarize other available pertinent information and data to facilitate the accomplishment of the authorized international study. This main report includes information on the Great Lakes system; on the development of tentative regulation study plans; on the estimated cost of regulatory works considered; and partial evaluation, in monetary terms, of the effects of the tentative regulation plans on United States interests.

592. U. S. Army Corps of Engineers. 1965. Water levels of the Great Lakes--report on lake regulation. Appendix A, hydraulics and hydrology. Corps of Engineers. North Central Div. Chicago, Ill. 48 p.

The purpose of this Appendix is to present a background of the hydrology of the Great Lakes, as it is presently known and with particular reference to the effect on lake levels and outflows of the contributory hydrologic factors. It discusses variations in the lake levels, the natural and artificial factors affecting the levels, and studies with a view to forecasting the levels. The method of treating the hydrologic factors in calculations for the lake regulation studies is discussed in this Appendix also.

593. U. S. Army Corps of Engineers. 1965. Water levels of the Great Lakes--report on lake regulation. Appendix B, lake regulation. Corps of Engineers. North Central Div. Chicago, Ill. 57 p. + 34 tables + 29 plates.

The purpose of this appendix is to present the tentative study plans developed in this investigation for regulating the lakes in accordance with the ranges of stages and other criteria adopted. The presentation provides the information that is prerequisite to economic evaluation of the results of the plans with regard to the interests of shore property ownership, navigation and power. These evaluations are found, respectively, in Appendix C, Appendix D and Appendix E. It also provides the information on the ranges of regulated lake outflows of the study plans which is required for designing and estimating the costs of regulatory works in the lake outlets. The designs for and the estimated costs of such regulatory works are found in Appendix F.

594. U. S. Army Corps of Engineers. 1965. Water levels of the Great Lakes--report on lake regulation. Appendix C, effect of lake regulation on shore property. Corps of Engineers. Chicago, Ill. 43 p. + 12 tables + 18 plates.

The purpose of this appendix is to review available information on past damages resulting from lake surface activities and to determine the effect on shore property resulting from regulation of the lake levels. This regulation would be such that the range of fluctuations would be narrowed by reducing the higher lake levels and raising the lower levels. (CE)

595. U. S. Army Corps of Engineers. 1965. Water levels of the Great Lakes--report on lake regulation. Appendix D, effect of lake regulation on navigation. Corps of Engineers. Chicago, Ill. 16 p. + 15 tables.

The purpose of this appendix D is to estimate the effect on navigation of regulating the levels of Lake Erie and Michigan-Huron under the plans considered for these two lakes. The appendix presents an evaluation of effects on commercial and recreational navigation resulting from the study plan for Lake Erie regulation. (CE)

596. U. S. Army Corps of Engineers. 1965. Water levels of the Great Lakes--report on lake regulation. Appendix E, effects on Niagara power of regulating Lake Erie. Corps of Engineers. Chicago, Ill. 26 p. + 5 plates.

The purpose and scope of this appendix is to arrive at the benefits to United States power that could be derived from the regulation of Lake Erie. The analysis developed herein discusses changes to the power installations in the United States, that would be required to realize the benefits. (CE)

597. U. S. Army Corps of Engineers. 1966. Cazenovia Creek-Flood plain information report--in the city of Buffalo and the town of West Seneca. Corps of Engineers, Buffalo District. Buffalo, N.Y. Brochure.

This pamphlet is a summary of the Cazenovia Creek Flood Plain information report. This report includes maps of the flood areas, flood profiles, information on past floods, guidelines for the use of the flood plain and ways of flood proofing structures. The purpose of the flood plain report is to identify the flood plain and the frequency of flood stages so that future development can make the most effective use of the area without increasing present damages.

598. U. S. Army Corps of Engineers. 1966. Coast of Lake Erie-Conneaut Harbor, Ohio. 89th Congress, 2nd Session. House Document No. 484. 51 p. + map.

A plan for improving Conneaut Harbor, a deep draft commercial harbor, is reported. The report consists of the construction of a pell-mell dike to establish a protected berthing area, two access dock channels and a launching basin. In addition to benefiting navigation, the dike and west breakwater would provide substantial benefits for sport fishing. An in-depth study of the details of the plan is given with its estimated benefits. (CE)

599. U. S. Army Corps of Engineers. 1966. Coast of Lake Erie-Elk Creek Harbor, Pennsylvania. 89th Congress, 2nd Session. House Document No. 512. 54 p. and map.

In its existing condition, Elk Creek is inadequate to accommodate the existing and prospective small boat traffic along the reach of the coast of Lake Erie between Erie, Pennsylvania and Conneaut , Ohio. Also, it is ideally located for a harbor of refuge, being about 11 miles east of Conneaut and about 22 miles west of Erie, both of which are Federally improved deep-draft harbors. Construction of a small boat harbor is, therefore, considered desirable in the interest of safe navigation. Plans of improvement which will most economically and effectively serve small craft are described. (CE)

600. U. S. Army Corps of Engineers. 1966. Great Lakes harbors study. Corps of Engineers. North Central Div. Chicago, Ill. 48 p. + 10 plates.

It has been determined that improvements at 30 harbors, and construction of one additional harbor, are fully justified to take full advantage of the 27-foot depths provided in the Great Lakes Connecting Channels, the Welland Canal, and the St. Lawrence Seaway. Since benefits to current programs of deepening the connecting channels will be realized only by improving harbors, a combined Great Lakes Connecting Channels-Harbors system analysis was required. The system analysis results in a benefit-cost ratio of 2.0 for the combined projects. (CE)

601. U. S. Army Corps of Engineers. 1967. Cost of Lake Erie-Cattaraugus Creek Harbor New York. 90th Congress, 1st Session. House Document No. 97. 65 p. + map.

Cattaraugus Creek in its existing condition is inadequate to accommodate the existing and prospective small-boat traffic along this reach of shore. The area around the mouth of the creek also experiences serious flooding nearly every year. Improvements needed to protect against flooding are quite similar to those needed for navigation. By combining improvements for the two purposes, greater benefits can be obtained.

602. U. S. Army Corps of Engineers. 1967. Water resources development in Michigan. Corps of Engineers. North Central Div. Chicago, Ill. 78 p.

This pamphlet has been prepared to describe the water resources development program of the Corps of Engineers in Michigan. It illustrates briefly the role of the Corps of Engineers in planning, constructing and operating projects for navigation, flood control, beach erosion, and

snagging and clearing. Projects in Lake Erie are: Navigation-Monroe Harbor, Huron River, Detroit River, and Rouge River (tributary to Detroit River); Flood control--Estral Beach.

603. U. S. Army Corps of Engineers. 1967. Water resources development in Ohio. Corps of Engineers. Ohio River Div. Cincinnati, Ohio. 93 p.

Water resources development studies were carried out by the Corps of Engineers in the state of Ohio. Navigation projects completed are in Ashtabula Harbor, Fairport Harbor, Huron Harbor, Port Clinton Harbor, Sandusky Harbor and Toledo Harbor.

604. U. S. Army Corps of Engineers. 1967. Water resources development in Pennsylvania. Corps of Engineer. North Atlantic Div. New York, N.Y. 102 p.

This pamphlet provides current information on the scope and progress of water resources development in the state of Pennsylvania. Beach erosion control projects are carried out in Presque Isle Peninsula at Erie.

605. U. S. Army Corps of Engineers. 1967. Zoning Coordinance, Town of Elma, Erie County, New York. Corps of Engineers. Buffalo District. Buffalo, N.Y. 23 p.

Regulations are made in accordance with a comprehensive plan and are designed to lessen congestion in the streets.

606. U. S. Army Corps of Engineers. 1968. Flood plain information, Cuyahoga River, Big Creek and Tinkers Creek, Cuyahoga County, Ohio. Corps of Engineers. Buffalo District. Buffalo, N.Y. 58 p. and charts.

This flood plain information study covers the inundated areas along Cuyahoga River. The U.S. Geological Survey is presently operating water-stage recording stations in the Cuyahoga River basin. To supplement data provided by available gage records, local government officials and property owners along the streams have been interviewed to determine high water marks. Newspaper files and historical documents were searched for information concerning past floods. From these data and studies of possible future floods on the Cuyahoga River, Big and Tinkers Creeks, the local situation, both past and present, has been developed. (CE)

607. U. S. Army Corps of Engineers. 1969. Dredging and water quality problems in the Great Lakes. Corps of Engineers. Buffalo District. Buffalo, N.Y. 16 p.

This is a summary of the draft of a report on a 2-year pilot study of harbor dredging operations and how they effect water quality and environment in the Great Lakes. Up to now, the Army engineers have been depositing most of the dredged-up material out in the lakes--specifically, in about a hundred selected disposal areas located near enough to the harbors to minimize hauling costs, yet far enough away to avoid interference with water intakes, beaches or other facilities.

608. U. S. Army Corps of Engineers. 1969. Dredging and Water Quality Problems in the Great Lakes, Summary Report (12 Volumes). Corps of Engineers, Buffalo District. Buffalo, N.Y. Unnumbered.

The investigations conducted during the study included sampling surveys of dredging and disposal activities, construction and operation of diked areas, treatment of the dredged sediments, modifications to dredge equipment and in dredging procedures, functional studies of the effects on lake ecology of open lake disposal, surveys of possible alternate disposal areas at 37 harbors and channels and an economic evaluation of benefits which might accrue from improved Great Lakes water quality as a result of cessation of open lake disposal of dredgings. (CE)

609. U. S. Army Corps of Engineers. 1969. Dredging and water quality problems in the Great Lakes, Summary Report Vol. 1. Corps of Engineers. Buffalo District. Buffalo, New York. 375 p.

The present report presents the results of a study conducted by the Corps of Engineers with cooperations of the Federal Water Pollution Control Administration to evaluate the effects of water quality of current dredging practices, including the disposal of dredged material in unconfined open water areas of the Great Lakes, as well as to develop the most practical methods for management of pollution problems that may be identified as resulting from dredging operations on the lakes. The investigations conducted during the study included construction and operation of diked areas, treatment of the dredged material, modifications to dredge equipment and in dredging operations,

functional studies of the effects on lake ecology of open-lake disposal, surveys of possible alternate disposal areas and an economic evaluation of benefits which might accrue from improved Great Lakes water quality.

610. U. S. Army Corps of Engineers. 1969. Water resources development in New York. Corps of Engineers. North Atlantic Division. New York, N.Y. 151 p.

This pamphlet provides current information on the scope and progress of water resources development within the State of New York. The following projects are summarized in the report: navigation projects in Buffalo Harbor, Dunkirk Harbor and Grandview Harbor; shoreline protection study and flood control in Cazenovia Creek, Ninemile Creek, Scajaquada Creek and Buffalo Creek.

611. U. S. Army Corps of Engineers. 1970. Dunkirk Harbor, New York. 91st Congress, 2nd Session. House Document No. 91-423. 80 p. and map.

Dunkirk Harbor is ideally located for a small-boat harbor and, if improved, would be an integral part of a chain of harbors along the coast of Lake Erie for the benefit of small boat navigation. The existing project provides for an adequate, well protected, entrance channel from the lake into the harbor, but additional protection and deepening in the harbor is considered necessary in the interest of safe and easy navigation by recreational craft. Modification of the existing project is warranted to effectively serve recreational boating and recommendations are given. (CE)

612. U. S. Army Corps of Engineers. 1970. Geneva-on-the-Lake, Ohio. 91st Congress, 2nd Session. House Document No. 91-402. 52 p. and map.

Geneva-on-the-Lake State Park in its existing condition has no accommodations for small-boat traffic. The State of Ohio has included a small-boat harbor in its plan for future development. The park is an ideal location for a harbor of refuge, the nearest harbors being Fairport Harbor, Ohio, about 17 miles west, and Ashtabula Harbor, Ohio, 12 miles east, both of which are federally improved deep-draft harbors. Construction of a small-boat harbor to provide needed protection accommodations for permanent berthing of such craft and in the general interest of safe navigation is desirable. The most economic and effective plans of improvement are described. (CE)

613. U. S. Army Corps of Engineers. 1971. Coastal zone and shoreland management in the Great Lakes, lakeshore physiography and use. Corps of Engineers. Chicago District. Chicago, Ill. 4 p. + 4 attachments.

The Shore Use and Erosion Work Group, Great Lakes Basin Framework Study, is completing a resource and land use inventory of the Great Lakes shorelands of the United States. This information will be used to define acceptable future alternative uses of the shorelands and to identify potential problems and conflicts in their development. The following items are being identified in the shoreland inventory: shoreline milages; existing shoreland use; shore types; beach zone material; public ownership; significant fish and wildlife, ecological and natural areas; erosion and flooding areas and locations of public beaches, harbors, electric power generating stations, water intakes and waste outfalls.

614. U. S. Army Corps of Engineers. 1971. Cuyahoga River Basin Ohio restoration study, first interim report. Corps of Engineers. Buffalo District. Buffalo, N.Y. 104 p. + 4 plates.

This is the first interim report of the Cuyahoga River Restoration study. Restoration of environmental quality, social well-being, and economic stability to this river basin will take place over a period of years. The report presents the scope of the longer-term framework plan plus an early-action program that will begin in fiscal year 1973. The framework plan presents a description of basin resource problems and needs and possible alternative means of dealing with the difficulties in pollution.

615. U. S. Army Corps of Engineers. 1971. Great Lakes region inventory report, national shoreline study. Corps of Engineers. North Central Division. Chicago, Ill. pp. 157-197.

This report concerns erosion and the need for protection of the shoreline zone of the United States portion of the Great Lakes. The shoreline zone or shorelands include the land, water, and the land beneath the water in close proximity to the Great Lakes shoreline. They represent a unique natural resource, rich in aesthetic and ecological values and their scenic attractions. This report is an investigation intended only to define the order of magnitude of the regional shore erosion problems.

616. U. S. Army Corps of Engineers. 1971. National shoreline study--shore management guidelines. Corps of Engineers. Washington, D. C. 56 p.

Information to assist decision makers to develop and implement shore management programs is provided. Shore management is defined as a process of (1) evaluating needs for preserving and enhancing the shore (2) examining techniques to satisfy the needs (3) formulating a plan and (4) implementing the plan. Preservation is seen as maintaining the shore essentially in its condition. Enhancement is seen as modifying the shore in a way that society judges it to be desirable.

617. U. S. Army Corps of Engineers. 1971. National shoreline study-shore protection guidelines. Corps of Engineers. Washington, D. C. 59 p.

These guidelines are for general use by those who are interested in suitable and economical methods of shore protection. They will be of value to those who may be knowledgeable in one or more of the shoreline processes but want additional information on the many forces that may affect a specific shore area. However, the general nature of this material precludes its use as a technical reference for preparing detailed design of protective measures.

618. U. S. Army Corps of Engineers. 1971. Plan of survey, Sandusky River, Ohio for flood control and allied purposes. Corps of Engineers. Buffalo District. Buffalo, N.Y. 11 p. + 8 inclosures.

The basic goal of the investigation is to develop a plan for the best use, or combination of uses, of water resources with a view toward flood control, and allied purposes. National economic development, environmental quality, social well-being, and regional development planning objectives will be considered. (CE)

619. U. S. Army Corps of Engineers. 1971. Water resources development in New York. Corps of Engineers. North Atlantic Division. New York, N.Y. 153 p.

This pamphlet provides current information on the scope and progress of water resources development within the State

of New York by the U.S. Army Corps of Engineers. Navigation projects and flood control projects are reviewed. In the Lake Erie Basin, this includes Barcelovia Harbor, Buffalo Harbor, Cattaraugus Harbor, and Dunkirk Harbor for navigation projects, and Smokes Creek, Cattaraugus Creek, Cazenovia and Buffalo Creeks, for flood control studies.

620. U. S. Army Corps of Engineers. 1972. Disposal of dredge spoil, problem identification and assessment and research program development. Corps of Engineers. Waterways Experiment Station. Vicksburg, Mississippi.

The Corps of Engineers, in fulfilling its mission in developing and maintaining the nation's navigable waterways, will continue to be responsible for extensive dredging operations. Considerable concern has developed as to the environmental impact of the operations, with particular emphasis on open water disposal, especially that involving spoil materials containing pollutants. As a partial solution to the problem, the Corps was authorized to conduct a 4-phase comprehensive nationwide study of the environmental impact of current disposal operations, including research leading to new or improved spoil disposal practices. This report contains the results of the first two study phases, i.e., problem identification and assessment and research program development. As a result of the assessment, it is concluded that the nature and magnitude of effects of dredging and spoil disposal on water quality and aquatic organisms are quite poorly known and require extensive research. Since the consequences of confined land disposal are similarly poorly known, considerable research is needed to make this a viable disposal alternative. Research is needed to develop and implement pollution criteria for use in disposal alternative decision making, as existing criteria have major identifiable weaknesses in implementation procedures, scope, and application. A broad-based research program is outlined and recommended to develop a wide choice of technically satisfactory, environmentally compatible, and economically feasible disposal alternatives to cover the wide variety of dredging and disposal operations and environments. In addition to extensive research concerning the effects of dredging and open water disposal on water quality and aquatic organisms, ways would be sought to facilitate and improve the overall effectiveness and acceptability of land disposal. Attention would also be devoted to modifying dredge plant equipment and

operational procedures to reduce environmental impact, and to phycical, chemical, and/or biological spoil improvement methods. Major attention would be given to considering spoil as a manageable resource, including utilization for marsh creation, wildlife habitat improvement or development, and beach nourishment. Completely new disposal concepts would be considered along with utilization of spoil for productive uses such as landfill and land enhancement. The recommended research program would cost about $30,000,000 over a 5-year period and would be accomplished by numerous groups and agencies under the direction of a multidisciplinary team.

621. U. S. Army Corps of Engineers. 1972. Great Lakes shoreline damage causes and protective measures. Corps of Engineers. North Central Div. Chicago, Ill. 22 p.

This report is organized in three parts:

I. A history and background discussion of lake levels, causing fluctuations and, most important, effects of lake level changes on shorelines.

II. A discussion of the role of Federal and State Governments in various activities and responsibilities on the Great Lakes related to water and shore areas.

III. A brief discussion of several emergency-type remedial measures, estimates of their cost and general statements on their applicability to various typical situations. This section is not intended to be used for design of permanent protective works without the advice and guidance of qualified engineering consultants.

622. U. S. Army Corps of Engineers. 1972. Pollution control in the Great Lakes. Congressional Record. Section 108 d. Federal Water Pollution Control Act. PH 8363-4. Unnumbered.

In recognition of the serious conditions which exist in Lake Erie the Secretary of the Army, acting through the Chief of Engineers is directed to design and develop a demonstration waste water management program for the rehabilitation and environmental repair of Lake Erie. A brief description of the program is included. (CE)

623. U. S. Army Corps of Engineers. 1972. USA CRREL Technical Publications. Corps of Engineers. Cold Regions Res. and Eng. Lab. Special Report 175. 375 p.

The bibliography lists all studies made by the Cold Regions Research and Engineering Laboratory of the Corps of Engineers. USA CRREL is a pioneer in the research and engineering investigation of snow, ice and frozen ground, on and below the earth's surface and in the associated environment. (UB)

624. U. S. Army Corps of Engineers. 1972. Winter Navigation Board. Proc. Great Lakes-St. Lawrence Seaway Winter Navigation Seminar Detroit--December 5-6, 1972. Corps of Engineers. Detroit District. Detroit, Mich. 238 p.

Outlining studies made in the United States to investigate the possibility of extending navigation on the Great Lakes-St. Lawrence Seaway. Impacts on economy, industry and environment are reviewed and discussed.

625. U. S. Army Corps of Engineers. 1973. Environmental impact statement: Cooperative beach erosion control project at Presque Isle, Pa. Corps of Engineers. Buffalo District. Buffalo, N.Y. 115 p.

A plan is developed for the preservation of the peninsula and its recreational facilities from natural erosion processes with the least amount of damage to its natural geological and ecological processes. Types of construction for breakwaters and groins used are discussed. General erosion problems are investigated and environmental impacts of the proposed action are examined with respect to aquatic ecology, wildlife, socio-economics, etc.

626. U. S. Army Corps of Engineers. 1973. Review of reports on Lake Erie-Lake Ontario waterway, New York, Summary report. Corps of Engineers. Buffalo District. Buffalo, N. Y. 16 p. + attachments.

Some major waterway improvements, in the form of a new waterway or structural improvements to the Welland Canal locks and channels, must be constructed between 1980-1990, to prevent the restriction of navigation between Lake Erie and Lake Ontario. This restriction would have an

adverse effect on the economic benefits that would otherwise develop with the natural growth of waterborne transportation in the Great Lakes areas. Five recommendations are made for reference.

627. U. S. Army Corps of Engineers. 1973. Review reports on Lake Erie-Lake Ontario waterway, New York, Appendix C--hydrology and hydraulics design. Corps of Engineers. Buffalo District. Buffalo, N.Y. 114 p. + 35 plates.

The scope of this study includes the design of the intake and discharge manifolds; filling and emptying culverts with appurtenances, bottom filling and emptying systems and sizing of the air venting system, all for the lock filling and emptying systems; consideration of surges in the overland section of the waterway; and design of a supply system to stabilize the pool levels in the overland section. Hydrological data presented in Section I. "Hydrology" of this appendix was used as the basis for the design of the waterway.

628. U. S. Army Corps of Engineers. 1973. Waste water management study summary report for Cleveland-Akron Metropolitan and three rivers watershed areas. Corps of Engineers. North Central Div. Chicago, Ill. 207 p.

The study is concerned with the formulation, design and assessment of the impacts of alternative plans for area-wide waste-water management for the Cleveland-Akron Metropolitan and three rivers watershed areas in Northern Ohio. The basic wastewater sources considered in the study are municipal sewage, industrial waste flows and combined and separate urban stormwater runoff. During this study, the Corps of Engineers examined a wide range of advanced wastewater treatment technologies, formulated alternative plans to achieve a range of effluent water quality goals and for selected alternative plans trated how implementation would be phased in accordance with guidelines established by the Federal Water Pollution Control Act Amendments of 1972.

629. U. S. Army Corps of Engineers. 1973. Water resources development in New York. Corps of Engineers. North Atlantic Div. New York, N.Y. pp. 19-24, 115-117.

This pamphlet provides current information on the scope and progress of water resources development within the State of New York by the Corps of Engineers. Projects included are those are those for navigation in Barcelona Harbor; for Flood Control in Cattaraugus Creek and Lackawanna.

630. U. S. Army Corps of Engineers. 1973. Water resources development in Ohio. Corps of Engineers. Ohio River Div. Cincinnati, Ohio. pp. 13-32.

Water resources development by the Corps of Engineers in the State of Ohio dates back to the early 1800's when snags and debris were removed from navigable waters. Activities have since expanded to include improving harbors and navigable channels; making engineering reports on the streams, shores and flood plains of the state; providing flood plain management services, etc. The projects of navigation are carried out in Ashtabula Harbor, Cleveland Harbor, Conneaut Harbor, East Harbor and Fairport Harbor. Local shore protection projects are also performed along the shoreline of Lake Erie.

631. U. S. Army Corps of Engineers. 1973. Water resources development in Pennsylvania. Corps of Engineers. North Atlantic Div. New York, N.Y. pp. 87-93.

This pamphlet provides current information on the scope and progress of water resources development within the Commonwealth of Pennsylvania by the Corps of Engineers. Projects in Lake Erie Basin include navigation in Erie Harbor, beach erosion control in Presque Isle Peninsula at Erie, and flood control.

632. U. S. Army Corps of Engineers. 1974. First annual report--the Great Lakes-St. Lawrence seaway winter navigation season extension demonstration program. Corps of Engineers. Detroit, Michigan. 100 p.

This is the first of three year-end reports to be prepared on demonstrated activities to facilitate commercial vessel operation into the winter months on the Great Lakes and St. Lawrence seaway. There are definite conclusions, based upon preliminary findings at this time, which show that there are engineeringly feasible measures which can provide an extension of the navigation season, and which appear to be economically feasible as well as environmentally acceptable.

633. U. S. Department of Health, Education, and Welfare. 1958. Municipal water facilities, inventory as of January 1, 1958. Region II- Delaware, New Jersey, New York, Pennsylvania. U. S. Dept. of Health, Education, and Welfare. Washington, D. C. Vol. 2. 149 p.

This volume is one of nine which, taken together, comprise an inventory of public water supply facilities in the United States as of January 1, 1958. The listing includes all facilities serving places having a 1950 population of 100 or more which have been reported by the respective State Departments of Health. The purpose of this inventory is to furnish up-to-date information on all water facilities for the use of industries and other private agencies and all levels of government. (CE)

634. U. S. Department of Health, Education, and Welfare. 1965. Conference in the matter of the pollution of the navigable waters of the Detroit River and Lake Erie and their tributaries in the State of Michigan. U. S. Dept. of Health, Education, and Welfare. Conf. Proc., Second Session. June 15-18, 1965. Volume 1-6. 1787 p.

This report summarizes a water pollution survey of the region which sought to identify the principal types and sources of pollution in the study area. 6 municipal and 42 industrial waste sources are samples. It includes waste-water discharges from municipal and industrial sources into the Detroit River. It itemizes treatment methods and facilities per sample and indicates the region and population affected by the discharge. Some recommendations are made.

635. U. S. Department of Health, Education, and Welfare. 1965. Conference in the matter of pollution of Lake Erie and its tributaries. U.S. Dept. of Health, Education, and Welfare. Conf. Proc. Cleveland, Ohio. August 3-6, 1965. Volume 1-4. 1099 p.

This conference is concerned with the matter of pollution of the interstate and Ohio interstate waters of Lake Erie and its tributaries. The definition of pollution and the sources of pollution are identified in the region of

study. Lake aging processes due to pollution are discussed. The report considers the quality characteristics of the waters as they exist today and trends in recent years. It evaluates the effects of waste discharges on water uses and summarizes the principal problems and needed corrections. Treatment plants and treatment are also discussed with respect to individual plants.

636. U. S. Deptment of Health, Education, and Welfare. 1965. Report on pollution of Lake Erie and its tributaries, Part 1- Lake Erie. Public Health Service. Div. of Water Supply and Pollution Control. U.S. Dept. of Health, Education and Welfare. Washington, D. C. 50 p.

This technical report is based on studies made over the past two years. The report considers the quality characteristics of the waters as they exist today and trends in recent years. It evaluates the effects of waste discharges on water uses, and summarizes the principal problems and needed correction. Part 1 is concerned with the lake in general.

637. U. S. Deptment of Health, Education, and Welfare. 1965. Report on pollution of Lake Erie and its tributaries, Part 2- Ohio, Indiana and Michigan sources. Public Health Service. Div. of Water Supply and Pollution Control. U.S. Dept. of Health, Education and Welfare. Washington, D. C. pp. 51-101.

This part deals with problems, their causes, and general remedial measures, in local areas tributary to Lake Erie within Michigan and Ohio, encompassing also headwater areas in Indiana. The area is divided into 6 sub-areas, each of which is discussed in one of the succeeding chapters.

638. U. S. Department of Health, Education, and Welfare. 1965. Report on pollution of Lake Erie and its tributaries, Part 3- New York and Pennsylvania. Public Health Service. Div. of Water Supply and Pollution Control. U.S. Dept. of Health, Education and Welfare. Washington, D. C. pp. 103-122.

Pollution problems in three areas tributary to Lake Erie within Pennsylvania and New York, are discussed in this section of the report. The three areas discussed are the Pennsylvania Basin, the Western New York Basin, and the Erie-Niagara Basin. (UB)

639. U. S. Environmental Protection Agency. 1966. Solid waste management, abstracts from the literature--1966. U.S. Env. Protection Agency. Washington, D. C. 173 p.

The literature represented by this bibliography does not include all the 1966 solid waste literature published. Numerous periodical and non-periodical titles covering both foreign and domestic literature were screened for inclusion. There are 670 articles that are abstracted. The bibliography is arranged in categories corresponding to the various administrative, engineering, and operational phases of solid waste management. Indices include subject, corporate author, author, and geographical location. (UB)

640. U. S. Environmental Protection Agency. 1971. Bulk refuse crusher facility. In: Solid Waste Management Demonstration Grant Projects, 1971, for grants awarded during the period, June 1, 1966-June 30, 1971. U.S. Env. Protection Agency. Washington, D. C. p. 105.

Objectives, procedures, and progress to date in the City of Buffalo of reducing the size of bulky burnable solid wastes by a heavy duty impact crusher to permit disposal by incineration. (UB)

641. U. S. Environmental Protection Agency. 1971. To determine the feasibility of shredding, mixing, and compacting a full range of municipal solid wastes for reclaiming submerged lands. In: Solid Waste Management Demonstration Grant Projects, 1971, for grants awarded during the period, June 1, 1966-June 30, 1971. U.S. Env. Protection Agency. Washington, D. C. p. 123.

Objectives, procedures, and progress to date in the City of Cleveland of combining shredded municipal solid wastes with fly ash, dewatered sewage, river and lake dredgins, and incinerator burnout to produce a dense, compacted sanitary mass suitable for use as fill in the reclamation of submerged lands. Pollutional effects of these compacts in Lake Erie will be investigated. (UB)

642. U. S. Environmental Protection Agency. 1971. Erie County refuse disposal project. In: Solid Waste Management Demonstration Grant Projects, 1971, for grants awarded during the period June 1, 1966-June 30, 1971. U.S. Env. Protection Agency. Washington, D. C. pp. 44-46.

The objectives, procedures and progress to date in Erie County, Pennsylvania, concerning solid waste management techniques. (UB)

643. U. S. Environmental Protection Agency. 1971. Solid waste management, abstracts from the literature, 1964. U.S. Env. Protection Agency. Washington, D. C. 242 p.

The present bibliography has been abstracted and is arranged in categories corresponding to the various administrative, engineering, and operational phases of solid waste management. Indices include subject, corporate author, author, and geographical location cited. The literature represented by the bibliography does not include all the solid waste literature published in 1964. Numerous periodical and non-periodical titles covering both the foreign and domestic literature were screened for inclusion. No effort was made to separate strictly technical material from that which is more general. There are 977 articles that are abstracted. (UB)

644. U. S. Environmental Protection Agency. 1972. Solid waste management, abstracts from literature, 1967, U.S. Env. Protection Agency. Washington, D. C. 353 p.

Although the literature represented by this bibliography does not include all the solid waste literature published in 1967, numerous periodical and non-periodical titles covering both the foreign and domestic literature were screened for inclusion. No effort was made to separate strictly technical material from that which is more general. There are 1286 articles that are abstracted. The bibliography is arranged in categories corresponding to the various administrative, engineering, and operational phases of solid waste management. Indices include subject, corporate author, author, and geographical location. (UB)

645. U. S. Environmental Protection Agency. 1972. Solid waste management, abstracts from the literature - 1968. U. S. Env. Protection Agency. Washington, D. C. 238 p.

Although the literature represented by this bibliography does not include all the solid waste literature published in 1968 numerous periodical and non-periodical titles covering both foreign and domestic literature were screened for inlcusion. No effort was made to separate strictly technical material from that which is more general. There are 1,232 articles that are abstracted. The bibliography is arranged in categories corresponding to the various administrative, engineering and operational phases of solid waste management. Indices include subject, corporate author, author, and geographical location cited. (UB)

646. U. S. Environmental Protection Agency. 1971. Thorrax solid waste disposal system. In: Solid Waste Management Demonstration Grant Projects, 1971, for grants awarded during the period June 1, 1966 - June 30, 1971. U. S. Env. Protection Agency. Washington, D. C. pp. 189-190.

Objectives and procedures of the County of Erie, New York concerning a new and improved method of solid waste disposal by high temperature combustion are presented. (UB)

647. U. S. Federal Water Pollution Control Administration. 1965. Conference in the matter of pollution of Lake Erie and its tributaries. U. S. Federal Water Pollution Control Admin. Conf. Proc. Buffalo, N.Y. August 10-11, 1965. Vol. 1-2. 496 p.

This conference is a continued discussion on pollution in Lake Erie in the States of Pennsylvania and New York. A summary of water pollution in the region is given. Industrial and municipal wastes are discussed and their treatment briefly mentioned. Some recommendations are proposed.

648. U. S. Federal Water Pollution Control Administration. 1966. Proceedings - third meeting on pollution of Lake Erie and its tributaries. U.S. Federal Water Pollution Control Admin. Washington, D.C. Vol. 1-2. 611 p.

Many of the experts that spoke to the committee made it very clear that knowledge of the pollution and its effects on this lake is extremely limited, and it would seem essential to devote much more effort to find what some of the other things are that have caused the problems of this lake. After having a federal report on the pollution in the area, reports on pollution control activities in each of the five states and statements by others, the conference unanimously agreed on a summary containing conclusions and recommendations. Requirements were set up for pollution standards. Selection of a medium date between the five states for completion of municipal and industrial waste treatment plants was discussed with a suggested date of completion by January 1, 1970. (UB)

649. U. S. Federal Water Pollution Control Administration. 1966. Report on water pollution in the Maumee River Basin. Federal Water Pollution Control Admin. Great Lakes-Illinois River Basin Project. Cleveland, Ohio. Unnumbered.

The waters of the Maumee River Basin are seriously degraded in quality. From waters that were once useful and generally free of harmful materials, this river basin has been degraded in quality to the point where, in several stretches, few legitimate uses may be made of the waters. Not only are activities such as swimming, boating, and fishing no longer available in a number of these locations, in several areas the water is not even of sufficient quality to be used for waste assimilation. The excellent sport fishing which formerly existed throughout the Maumee Basin is now virtually non-existant. (CE)

650. U. S. Federal Water Pollution Control Administration. 1966. Storm water runoff from urban areas, selected abstracts of related topics. Eng. Activities, Basic and Applied Sci. Program, Cincinnati Water Res. Lab. Federal Water Pollution Control Admin. Cincinnati, Ohio. 98 p.

This report contains 286 abstracted papers on "Storm water runoff from urban areas". Following topics are covered: instrumentation; overflows and regulation devices; sewer hydraulics; combined sewer systems; sanitary sewer systems; stormwater sewer systems; stormwater-quality and pollution; surveys, policies and legislation; treatment methods and; urban hydrology.

651. U. S. Federal Water Pollution Control Administration. 1966. Water pollution control, waste treatment and water treatment--Selected biological references on fresh and marine waters. U.S. Federal Water Pollution Control Admin. Washington, D. C. 126 p.

This book of selected references dealing with water quality and use has been prepared for persons interested in and responsible for biological aspects of water pollution control, waste treatment and water treatment. Industrial wastes are also listed.

652. U. S. Federal Water Pollution Control Administration. 1967. Conference proc., pollution of Lake Erie and its tributaries. U. S. Federal Pollution Control Admin. Washington, D. C. Vol. 1, 2. 488 p.

A comparison of 1963 and 1966 water quality data from Lake Erie indicates that there has been no significant change. There is not enough available data to determine any trends in water quality. After hearing a federal report on pollution in the area, reports on pollution control activities in each of the five states and statements by others, the conference found that the requirements set up at the first two sessions of the conference were fully met. The five states had relatively uniform requirements for their treatment and disinfection of the effluent where there is a pathogenic danger. The states had very detailed plans on industrial waste sources. The time schedule for completion of industrial waste facilities was discussed and was considered reasonable according to the states. (UB)

653. U. S. Federal Water Pollution Control Administration. 1968. Lake Erie bathing beach water quality. U.S. Federal Water Pollution Control Admin. Great Lakes Region. Cleveland, Ohio. Unnumbered.

All Lake Erie beaches are adversely affected at least occasionally by bacterial pollution, esthetic impartment, or both. Bacterial pollution varies from major continuous problems at some beaches to occasional or infrequent problems at others. Pollution sources to Lake Erie beaches include sewer overflows, municipal treatment plant

bypasses, inadequately disinfected effluents, septic tank discharges, urban and rural runoff, and industrial waste discharge. The purpose of bathing beach surveillance program is not only the determination of water quality, but the location of all pollution sources to the beach and its effect on water quality.

654. U. S. Federal Water Pollution Control Administration. 1968. Lake Erie environmental summary, 1963-1964. U. S. Federal Water Pollution Control Admin. Great Lakes Region. Cleveland, Ohio. 170 p.

This report is an attempt to summarize the information gathered in the years 1963 through 1965. The purposes are (1) to provide a document for validating previous reports on the pollution problems in Lake Erie, and (2) to provide a base for comparison with future lake surveillance data.

655. U. S. Federal Water Pollution Control Administration. 1968. Lake Erie report: A plan for water pollution control. U.S. Federal Water Pollution Control Admin. Great Lakes Region. Chicago, Ill. 107 p.

The cleanup of Lake Erie is less a problem of engineering than it is a problem of diverse, inadequate and unwieldy changing governmental policies, funding and management. The technical engineering requirement being only their coordinated applications. As an international and interstate body of water, management involves two national governments, five state governments, one provincial government and a multitude of local governments. Primary responsibility for pollution control lies at the state and provincial levels. A plan for water pollution control is proposed and recommendations are made. This report also reviews all problems in the lake.

656. U. S. Federal Water Pollution Control Administration. 1968. Lake Erie surveillance data summary, 1967-1968. U. S. Federal Water Pollution Control Admin. Great Lakes Region. Cleveland, Ohio. 65 p.

The purpose of the reports is to chronicle water quality changes in Lake Erie. It is not the intent to provide detailed interpretative evaluations. However, the compiled data, along with information collected by other agencies, should be useful to those engaged in lake water resources management including pollution control.

657. U. S. Federal Water Pollution Control Administration. 1968. Proceedings. Conference on pollution of Lake Erie and its tributaries--Indiana, Michigan, New York, Ohio, Pennsylvania. Technical Session. August 26, 1968. U.S. Federal Water Pollution Control Admin. Cleveland, Ohio. 134 p.

This technical meeting is concerned with the problem of the nutrient input on the aging and eutrophication of Lake Erie with particular emphasis on the phosphate problem. The meeting is held under the question and answer format. The specialist in the conferees provides the answer. (UB)

658. U. S. Federal Water Pollution Control Administration. 1968. Proceedings. Conference on pollution of Lake Erie and its tributaries--Indiana, Michigan, New York, Ohio, Pennsylvania. Fourth Session. October 4, 1968. Cleveland, Ohio. U.S. Federal Water Pollution Control Admin. Washington, D. C. 134 p.

The problem of nutrient input and eutrophication in Lake Erie is discussed. Phosphate removal program (80% of removal) is the central issue. The terminal date for construction of those phosphate removal facilities is set on 1971. (UB)

659. U. S. Federal Water Pollution Control Administration. 1968. Proceedings. Progress evaluation meeting, pollution of Lake Erie and its tributaries--Indiana, Michigan, New York, Ohio, Pennsylvania. June 4, 1968. Cleveland, Ohio. U.S. Federal Water Pollution Control Admin. Washington, D. C. 467 p.

This report is the progress meeting of the conference in the matter of pollution of the waters of Lake Erie and its tributaries, held at the Pick Carter Hotel, Cleveland, Ohio, on June 4, 1968. Pollution due to industrial wastes as well as municipal sewage wastes are discussed. Status of municipal waste treatment facilities in Ohio which direct to Lake Erie are listed. The alternate waste disposal areas for polluted harbors are reviewed.

660. U. S. Federal Water Pollution Control Administration. 1969. Proceedings. Progress evaluation meeting on pollution of Lake Erie and its tributaries--Indiana, Michigan, New York, Ohio, Pennsylvania. June 27, 1969. Cleveland, Ohio. U.S. Federal Water Pollution Control Admin. Washington, D.C. Vol. 1 and 2. 552 p.

This meeting is the progress measure on efforts to clean up pollution in Lake Erie during the past four years. As it reports, "although there have been some significant steps taken to clean up, we are losing the battle to save this vital resource". The warnings which indicate the lack of pro~ ss are listed and discussed. Progress reports made by individual states are included to review the compliance status of the previously approved abatement programs and time schedules and information on recent pollution control activities affecting water quality in Lake Erie. (UB)

661. U. S. Federal Water Pollution Control Administration. 1969. Stream pollution and abatement from combined sewer overflows, Bucyrus, Ohio. U.S. Federal Water Pollution Control Admin. Washington, D.C. Water Pollution Control Res. Ser. Dast-32. 197 p.

This report contains the results of a detailed investigation and comprehensive technical study to evaluate the pollutional effects from combined sewer overflows on the Sandusky River at Bucyrus, Ohio, and to evaluate the benefits, economics and feasibility of alternate plans for pollution abatement from the combined sewer overflows.

662. U. S. Federal Water Pollution Control Administration. 1970. Combined sewer regulator overflow facilities. U.S. Federal Water Pollution Control Admin. Washington, D.C. Water Pollution Control Res. Ser. 11022 DMU 07/70. 139 p.

This report gives the result of an extensive study conducted by the American Public Works Association (APWA) Research Foundation concerning the design, operation, maintenance and application of combined sewer overflow regulators. The findings and recommendations of this report point to the need for the development of devices which will alow control of both the quality and quantity of the overflows. Among the areas studied are Cleveland and Detroit. (UB)

663. U. S. Federal Water Pollution Control Administration. 1970. Proceedings in the matter of pollution of Lake Erie and its tributaries - Indiana, Michigan, New York, Ohio. Fifth Session. Detroit, Michigan. June 3-4, 1970. U.S. Federal Water Pollution Control Admin. Washington, D.C. Vol. 1-2. 740 p.

Progress reports on industrial and municipal waste clean-up are reviewed. Mercury pollution in Lake Erie and its tributaries is discussed in detail. It is found that the big sources of pollution have been and remain in the industrial and municipal sources. (UB)

664. U. S. Federal Water Pollution Control Administration. 1971. Agricultural pollution of the Great Lakes Basin. U.S. Federal Water Pollution Control Admin. Washington, D. C. Water Pollution Control Res. Ser. 13020-07/71. 94 p.

This report is intended to be a document concerning abatement of pollution of the Great Lakes Basin, as specifically influenced by agricultural and related sources. It was compiled by technical personnel from appropriate fields in universities and government departments in Canada and the United States. Primarily, it relates to the identification of the impact of agricultural and related activities on the pollution of the Great Lakes Basin. (UB)

665. U. S. National Oceanic and Atmospheric Administration. 1972. Lake Erie. In: Great Lakes Pilot, 1972. U.S. Nat. Oceanic and Atmospheric Admin. Nat. Ocean Survey. Lake Survey Center. Detroit, Mich. pp. 177-270.

Information concerning Lake Erie's dimensions, surface elevations, and other data, and detailed descriptions of coast line, harbors, islands, and reefs. (CE)

666. U. S. National Oceanic and Atmospheric Administration. 1974. Detroit River. In: Great Lakes Pilot, 1974. U.S. Nat. Oceanic and Atmospheric Admin. Nat. Ocean Survey. Lake Survey Center. Detroit, Mich. pp. 283-293.

The text of this pilot has been edited as a complete revision compiled from former pilots. Topics included are detailed descriptions of coast line, harbors, island, reefs, and season of navigation. (UB)

667. U. S. National Oceanic and Atmospheric Administration. 1974. Lake Erie. In: Great Lakes Pilot, 1974. U.S. Nat. Oceanic and Atmospheric Admin. Nat. Ocean Survey. Lake Survey Center. Detroit, Mich. pp. 187-281.

The text of this pilot has been edited as a revision compiled from former pilots. Topics included are detailed descriptions of coast line, harbors, island and reefs, and season of navigation. (UB)

668. U. S. News and World Report. 1965. Filth in the Great Lakes: What can be done about it. Interview with an authority on water pollution. U.S. News and World Report. December 13. pp. 58-61.

In an exclusive interview, the problem of pollution in the Great Lakes, especially the badly polluted Lake Erie, is analyzed by a noted Canadian authority, Dr. George B. Langford. He explains the causes of pollution, tells what can be done about it, what it means to the public and to industry, and how much a cleanup is going to cost.

669. Unwin, H. D. 1949. Treatment of wastes in metal working plant. Sewage Works J. 21(3):501-509.

Data on industrial waste treatment system for a ball bearing plant of General Motors, Sandusky, Ohio are reported. Characteristics of wastes and waste collection system, flow diagram of waste treatment process, description of treatment processes, "Cyclator" and sludge settling basin are discussed. (BECPL)

670. Vaughan, R. D. 1963. Detroit River - Lake Erie Project. Water and Sewage Works. 110(9):305-307.

An engineering evaluation section was set up to summarize data and help guide current operations in water pollution control studies to: determine extent of pollution in United States portion of Detroit River and Michigan section of Lake Erie; investigate the principal sources of pollution in this area; determine the effect of pollution on various water uses; and prepare plans for improving water quality. Program Evaluation and Review Technique (PERT) was selected for program planning, management and development. The progress in this area is reported. (UB)

671. Verber, J. L. 1966. Inertial currents in the Great Lakes. Univ. Mich. Great Lakes Res. Div. Great Lakes Res. Div. Pub. 15:375-379.

The Great Lakes-Illinois River Basins Project has completed field studies on currents in Lakes Michigan, Erie, and Ontario. One of the dominant effects appears to be that the earth's rotation produces right hand acceleration to the currents. The effect of the earth's rotation on water movements in the Great Lakes has been portrayed in a film. Five patterns of flow are displayed: straight-line flow, sinusoidal or oscillatory, half moon, circular or spiral, and rotary or screw. Inertial flow is found in the Great Lakes at all depths and in all seasons as well as under ice cover. With few exceptions, such as the Straits of Mackinac and shallow inshore stations, some type of inertial flow is evident in the lakes.

672. Verduin, J. 1962. Energy flow through biotic systems of Western Lake Erie. Great Lakes Basin. Am. Assoc. Advancement Sci. Pub. 71: 107-121.

Western Lake Erie has a high vertical turbulence which is created by the seiche-generated currents. The eddy diffusivity averages 25 square centimeters per second. A relatively high rate of photosynthesis, amounting to 500 millimoles of CO_2 fixed per square meter per day, is supported by a well-mixed water column in which the products of respiration from the dynamic zone are transported to the euphotic zone, and products of photosynthesis are moved to the dysphotic zone at a high rate. Several quantities related to energy flow nave been established for Western Lake Erie and are considered to have wide application to other aquatic habitats.

673. Verduin, J. 1969. Man's influence on Lake Erie. Ohio J. Sci. 69(2):65-70.

Conversion of northwestern Ohio's Great Black Swamp to farmland during the last half of the nineteenth century had a profound, but scantily documented influence on Lake Erie. Silts, once largely filtered out by the swampland vegetation, were, with the destruction of that vegetation, carried into Lake Erie, where their effect in reducing light penetration has significantly altered the lake's biota.

More recently a spectacular enhancement of plant nutrients, especially phosphorus which has increased five-fold since 1948, has supported nuisance levels of plant growth. This plant growth creates severe oxygen depletion near the lake bottom and is therefore responsible for additional major and undesirable changes in species composition of plant and animal communities. The obvious solution to this problem is

the removal of the plant nutrients from the waters before they enter Lake Erie. The "living filter" treatment, in which sewage-plant effluents are filtered through root zones of plant communities, seems most promising.

674. Wagnitz, M. F. 1931. Storm water pumping station at Detroit. Eng. News-Record. 107(5):182-184.

Connors Creek Station serves a low flat area of 2,733 acres. Circular buildings house four 84-inch vertical shafts with motor driven screw pumps of 500 sec. ft. capacity. No trash racks are at the intake. (BL)

675. Walker, A. C. 1973. Ground water resources of Ohio. In: Can Ground Water Supply Tomorrow's Needs? John Carroll Univ. Cleveland, Ohio. Unnumbered.

The vast majority of available fresh water lies underground, yet public knowledge of ground water is very limited. This paper discusses ground water availability in Ohio and describes how recharging of this resource is accomplished.

676. Walker, E. G. 1926. The St. Lawrence Waterway to the sea. Proc. A.S.C.E.--Discussions. 52:282-288.

E. G. Walker discusses the interests of lake navigation that should be considered as a primary feature of such a waterway as the proposed St. Lawrence Waterway.

677. Walters, L. J. Jr., T. L. Kovacik and C. E. Herdendorf. 1974. Mercury occurrence in sediment cores from Western Lake Erie. Ohio J. Science. 74(1):1-19.

The Detroit River is the major source of mercury contamination in the sediments of Western Lake Erie. Analyses of 63 sediment cores indicate that the mercury consists of two components: a high-concentration (0.5 to 4.0 ppm of dry sediment) mercury-enriched surface zone, whose concentration decreases pseudo-exponentially with depth, and a low-concentration (0.04 to 0.09 ppm of dry sediment) relatively constant-background zone. Mathematical modeling of the mercury concentration as a function of depth in these sediment cores and subsequent statistical analysis of the apparent constant-concentration levels reveals that two log-normal distributions are necessary to describe these observed constant concentrations. Any mercury concentration within the

sediment in excess of the lower (natural) background level plus one standard deviation is defined as being due to pollution. Such calculations of the pollution component for these 63 cores serve as the basis for an estimate of the total mercury that has been added through pollution sources. The mercury-pollution load for bottom sediments of Western Lake Erie is estimated to be 228 metric tons.

678. Walton, R. J. 1969. Directory and project forecasts, the Great Lakes. Corps of Engineers. Lake Survey Div. Detroit, Mich. 166 p.

The information from these forecasts will allow investigators to coordinate planned projects in order to avoid duplication of programs and data collection. In addition to its primary purpose to provide an annual volume of forecasted oceanographic projects for the Great Lakes, it serves as a directory and catalog for answering numerous information requests received by the data center.

679. Weiler, H. S. 1969. Prediction of vertical profiles of wind speed over a lake. Internat. Assoc. Great Lakes Res. Proc. 12th Conf. on Great Lakes Res. pp. 492-503.

Two schemes for predicting the vertical profile of mean wind speed over a lake from measured values of air temperature and wind speed at one height, as well as the surface water temperature, were tried. A total of 787 vertical wind speed profiles were analyzed, and showed that there was no significant difference in the ability of either the "engineering formula" approach or the modified Morin-Obukhov wind profile approach, to predict the vertical profile within a standard deviation of 3.6% at the worst.

680. Welsh, J. P. 1972. Ice properties and their relation to ship transit in the Great Lakes. Proc. 1st Federal Conf. on the Great Lakes. Interagency Comm. on Marine Sci. and Eng. Federal Council for Sci. and Tech. Washington, D.C. pp. 274-287.

Adequate information on the physical properties of lake ice relevant to the ship-ice interaction for domestic icebreaker engineering is not presently available.

In response to this need the Coast Guard ice research program is directly concerned with the identification and quantification of the physical properties of ice which affect ship transit. Physical properties, such as the flexural

strength, coefficients of static and kinetic friction, density, thermal characteristics of the ice column, and and the areal distribution and thickness are the properties presently under investigation.

Field experiments were conducted on the ice at various locations in the Great Lakes during the winter of 1972. All measurements obtained thus far have been in-situ field determinations.

Peliminary results indicate that the frequency distributions of the measurement values obtained for all the physical properties as above are not normal distribution functions. The consequence of this observation is that descriptive statistics like the arithmetic mean and standard deviation could be misleading if used as representative numbers for substitution in various equations for engineering purposes. Alternative descriptive statistics of central tendency and dispersion are considered and partially evaluated. Analysis of variance techniques, both parametric and nonparametric, have been used where appropriate as determined by examination of the relevant assumptions to assess the character of the observed variation. Recommendations based on the present conclusions are to continue the 1972 work during the winter of 1973 with increased measurement precision and experimental control as primary objectives.

681. Whipple, G. C. 1906. The quality of the water supply of Cleveland, Ohio. Eng. Record. 54(19):508-512.

The quality of the water supply from Lake Erie is reported. A diagram is provided to show the relation between floods, winds and typhoid fever rate in Cleveland. A survey report on the amount of chlorine in parts per million in the water of Lake Erie is also included. Curves showing quality of water at different distances from the shore is discussed with respect to bacteria count, turbidity and chlorine content. (BECPL)

682. Williams, G. S. 1911. The uses of the Great Lakes. Eng. News. 66(24):716.

The use of the Great Lakes for the development of power to supply light, heat and energy to the communities along their shores is an entirely legitimate use; and one that, as the supply of available coal decreases, may in time become paramount, at least over navigation. Lake levels thus play a very important role in this respect. Control of the levels is discussed. (BL)

683. Wilson, J. T. and J. C. Ayers. 1968. An effort to mobilize inter-university water related research in the Great Lakes. In: Proc. of Great Lakes Water Resources Conf. June 24-26, 1968. Toronto, Canada. pp. 473-489.

The report describes the format which provided an opportunity for researchers of many disciplines to focus upon systems analysis models of the Great Lakes. Early in the study it was determined that a water quantity model of the entire system is necessary and feasible. Attempts at a water quality model for the Great Lakes region is suggested on a subregional, subsystem basis with the expectation of subregional groupings when data and systems technology permit.

The need for a gaming-simulation model, a regional economic growth model, a water-related data information system, and institutional research is expressed. Research efforts which supplement and support the water quantity and water quality subsystems are itemized with suggested priorities. Under the auspices of the Committee on Institutional Cooperation, C.I.C., water-related research requirements in the Great Lakes region have been appraised on a region-wide scale, and it is hoped to promote multidiscipline--multi-university research collaboration never before attempted.

684. Winchester, J. W. 1969. Pollution pathways in the Great Lakes. Limnos. 2(1):21-24.

The Great Lakes, the largest fresh water system in the world, are particularly vulnerable to water pollution. Once polluted, they may take a very long time to be cleansed by natural processes. At the present time, countless organic and inorganic substances are entering the lakes from municipal, industrial and agricultural sources far faster than the lakes can flush them out down the St. Lawrence River. A monitoring program and treatment plan are required in order to have clean water and better water quality.

685. Winslow, J. D., G. W. White, and E. E. Webber. 1953. The water resources of Cuyahoga County, Ohio. U.S. Geological Survey. Water Resources Div. 123 p. + 60 plates.

This report describes the water resources of Cuyahoga County, Ohio, which includes the city of Cleveland. The streams that drain this county are the Cuyahoga River, the Rocky River, the Chagrin River, and their tributaries, together with several short streams that drain directly into Lake Erie. The best available source of surface water in Cuyahoga County so far as quantity and regularity of flow are concerned, excluding Lake Erie, is the Cuyahoga River. By storing flood waters, the Chagrin River could be made an excellent source of supply. The other streams in Cuyahoga County are generally poor sources of surface supply because of their low base flows and large volumes of storage required to maintain specified flows. (CE)

686. Wisner, G. Y. 1895. Regulation of lake levels with reference to improving waterways. In: Proc. 1st Annual Convention. Internat. Deep Waterways Assoc. Cleveland, Ohio. September 24-26, 1895. pp. 125-134.

The plan for a nearly constant depth of a navigable channel in the Great Lakes is proposed by regulating the lake levels. The argument is based upon the cost of vessel construction and transportation rates. It is suggested that a fixed depth of over 21 feet constructed from lakes to tide water is required. Methods of improving the waterway of the lakes in a low water session is necessary. (UB)

687. Wright, H. 1926. Lake Erie as a public water supply. Am. Water Works Assoc. J. 16(6):737-744.

Lake Erie is manifold in its uses for industry, shipping, and recreation. It is a local, interstate and international highway and a public water supply. The proper use of Lake Erie is discussed. The interrelation of water purification and sewage treatment is reviewed. Pollution problems along the shore of Lake Erie are examined. (BL)

688. Young, C. H. 1946. Water quality and pollution control in Western Pennsylvania. Am. Water Works Assoc. J. 38(4):511-524.

Consideration of effects of various pollutants on streams and lakes are reported. Data on drainage basins and pollution are presented for Lake Erie Basin, Beaver River Basin, Allegheny River Basins and lower Ohio. Map, tables and charts are included. (UB)

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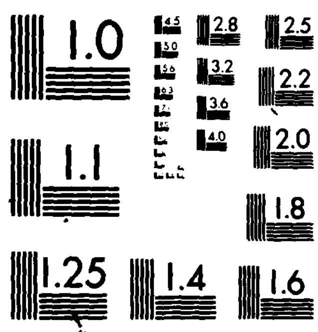
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VII. ABBREVIATIONS

Admin.	Administration
Am.	American
Ann.	Annual
A.S.C.E.	American Society of Civil Engineers
Assoc.	Association
BECPL	Buffalo and Erie County Public Library
Bio.	Biology, Biological
BL	Bell Library - State University of New York at Buffalo
Bull.	Bulletin
CE	Corps of Engineers - Buffalo District Library
Chem.	Chemistry, Chemical
Co.	Company
Comm.	Commission, Committee
Conf.	Conference
Cons.	Conservation
Corp.	Corporation
Dept.	Department
Div.	Division
Ecol.	Ecology, Ecological
Ed.	Editor
Eng.	Engineering
Engr.	Engineer (s)
Env.	Environmental
Fed.	Federal
Fish.	Fishery, Fisheries
Geog.	Geography, Geographic, Geographical
Geol.	Geology, Geological
Geophys.	Geophysical
IJC	International Joint Commission
Ill.	Illinois
Inc.	Incorporated
Info.	Information
Inst.	Institute
Internat.	International
Invest.	Investigation
J.	Journal
Lab.	Laboratory
Limn.	Limnology
M.A.	Master of Arts
Mag.	Magazine
Memo.	Memorandum

Meteor.	Meteorology, Meteorological
Mich.	Michigan
M.S.	Master of Science
M.Sc.	Master of Science
Nat.	Natural
No.	Number
NOAA	National Oceanic and Atmospheric Administration
NTIS	National Technical Information Service
N.Y.	New York
Oceanog.	Oceanography
Ont.	Ontario
p.	Page
pp.	Pages (inclusive)
__p.	Pages (total in report)
Pa.	Pennsylvania
Petrol.	Petroleum
Proc.	Proceedings
Pub.	Publication
Rd.	Road
Rept.	Report
Res.	Research
Rev.	Review
Sci.	Science (s)
SE	Science and Engineering Library - State University of New York at Buffalo
Soc.	Society
Surv.	Survey
Tech.	Technical, Technology, Technological
Trans.	Transactions
Univ.	University
U.S.	United States
Vol.	Volume (s)
Wisc.	Wisconsin

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